JUNE 1976

MDC G6401
DPD 485
DR MA-04

(NASA-CR-149944) STS/SPACELAB PAYLOAD UTILIZATION PLANNING STUDY: EXECUTIVE SUMMARY (McDonnell-Douglas Astronautics Co.) 57 p HC $4.50 CSCL 22A

N76-28262

Unclas
G3/16 45854

STS/SPACELAB PAYLOAD UTILIZATION PLANNING STUDY

NAS8-31146

EXECUTIVE SUMMARY

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY - WEST

MCDONNELL DOUGLAS CORPORATION

PREFACE

The first 4 months of the STS/Spacelab Payload Utilization Planning Study under Contract NAS8-31146 defined a process for translating payload requirements into firm flight assignments. This effort was documented in MDC G5987, STS/Spacelab Payload Utilization Planning (S/SPUP) Study, Phase I Final Report.

At the end of the fourth month, NASA redirected the study from development of scheduling software to concentration on the planning aspects of the problem. The study guidelines changed accordingly. NASA furnished a baseline description (master flow and management framework) of an STS Utilization Planning (SUP) system. The goals of the remainder of the study were to simplify this baseline where possible, define its products, and determine the resources required to operate it. The result of this in-depth development was to be a specification describing the system and its implementation.

In the course of performing this work, the different aspects of the SUP system were discussed with the NASA operations centers (JSC, KSC, and GSFC). In addition, progress was reported regularly to the NASA Steering Group for Payload Operations Concepts Studies, and the recommendations of the Steering Group were incorporated as additional guidelines.

This report presents a summary description of a process for STS/Spacelab payload utilization planning and recommendations on its products and implementation.

It should be noted that subsequent to the completion of the study analysis effort, but prior to final documentation, certain roles

and missions within NASA were redefined. As a result, the overall SUP master flow and management framework will be updated in the Integrated Payload and Mission Planning (IP&MP) Study which supersedes SUP. This will include deletion of separate Integrated Missions Planning and Analysis (IMAP) reports for each mission as recommended in this study and incorporation of their basic function into the remaining IP&MP documentation. The basic results are valid; however, it is recommended that a premission planning process be started soon for the early 1980's missions. This will require some updating of the process definition by the IP&MP Study. The deletion of the IMAP's as a discrete product and the updating of the process by the IP&MP Study are expected to reduce the manpower requirements identified in this report.

Questions regarding this report may be directed to:

- R. L. Brown, COR, S/SPUP Study
  NASA/Marshall Space Flight Center
  PM-01
  Marshall Space Flight Center, Alabama 35812
  Telephone (205) 453-0461

- R. E. Holmen, Manager, S/SPUP Study
  McDonnell Douglas Astronautics Company
  13-2
  Huntington Beach, California 92647
  Telephone (714) 896-4694

GLOSSARY

AA	Associate Administrator
CCB	Change Control Board
CER	Cost estimating relationship
ECR	Engineering Change Request
FAD	Flight Approval Document
IMAP	Integrated Missions Analysis and Planning
IP&MP	Integrated Payload and Mission Planning
JURG	Joint Users Requirements Group
LRF	Launch Recovery Facility
MCC	Mission Control Center
MIRADS	Marshall Information, Retrieval, and Display System
MMSE	Multiple-Mission Support Equipment
OFT	STS flight testing
OMB	Office Management Budget
OPPI	Office of Planning and Program Integration
PAD	Project Approval Document
PCR	Payload Changeout Room
PCM	Preview Cargo Manifest
PDR	Preliminary Design Review
POC	Payload Operations Control Center
POP	Program Operating Plan
PPDB	Payload Planning Data Bank

PRR	Preliminary Requirements Review
QR	Quick response
RID	Review Item Discrepancy
ROM	Rough Order of Magnitude
SCI	Schedule-Critical Item
SFOP	Spaceflight Operations Plan
SPDA	STS Payload Data Analysis
SPRAG	STS Payload Requirements and Analysis Group
SSPPSG	STS Payload Planning Steering Group
S/SPUP	STS/Spacelab Payload Utilization Planning
STS	Space Transportation System
SUP	STS Utilization Planning
SURB	STS Utilization Review Board

Section 1
INTRODUCTION

The Space Transportation System (STS) Utilization Planning (SUP) process will provide the means by which the orbital flight requirements of the national space program can be translated into definitive plans for STS and payload development, procurement, operations, and support leading to authorization and funding of STS and payload project activities.

The STS is intended to be operated continuously by NASA for an indefinite length of time, perhaps several decades. With projected flight rates as high as 60 per year, the system will perform many different kinds of missions for many different users. Many of the needs that the system must meet will be defined only in approximate terms at the time when STS utilization planning is required. For example, STS development or procurement lead-time requirements may predate authorization of payloads and missions requiring those STS resources.

Thus, planning for utilization of the STS must not only account for the complexities of the transportation system, the payloads, and the supporting functions. It must also be able to cope successfully with uncertainty. Payloads that are likely to emerge in the future as well as those that have already been authorized must be accounted for, and allowance must be made to respond to contingencies such as payloads that are not ready on time, missions that are aborted and must be rescheduled, and emergencies that demand the servicing of payloads in orbit or the rescue of personnel from space.

In addition, the utilization-planning process must provide a means for coordinating the planning of many different NASA entities. Numerous organizations at the Centers and Headquarters will be involved in payload development, STS operations, and mission support, and the plans prepared by these organizations must be compatible and mutually supportive.

Finally, to be compatible with the way the Government does business, the SUP process must be synchronized with the NASA and federal planning, budgeting, and authorization cycles.

This report describes the planning process recommended to meet these requirements which was developed according to the guidelines and objectives noted in Table 1.

Section 2 of this report summarizes the rationale and primary products of STS utilization planning. Section 3 provides an overview of the process which is further defined in Section 4. Section 5 summarizes the implementation of the system. The report concludes with Section 6 which summarizes the major recommendations resulting from the study.

Table 1

GUIDELINES AND OBJECTIVES FOR THE SUP PROCESS

Guidelines	Objectives
The SUP process shall: • Be consistent with the Government-furnished baseline master flow and management concept. * • Do planning to the schedule-critical item (SCI) level. • Help coordinate planning which cuts across two or more program or Center interfaces. • Provide long-range planning which encompasses the operational lifetime of the STS (nominally 12 years). • Emphasize planning within a 6-year horizon. • Support translation of payload concepts from long-range planning into the approval and implementation phase. • Be limited to preliminary and long-range planning; detailed mission and flight planning or detailed scheduling and assignment of STS resources shall be performed by the appropriate Operations Office/Centers. • Be as simple as possible requiring a minimum of new resources, new documentation, or changes to current procedures, planning, and reporting methods and cycles. • Be coordinated with the operations centers during its development to assure the end product is useful to them.	• To provide direct support to the agency's planning for utilization of the STS/Spacelab (payloads, missions, and integration). • To provide a central point for compilation, validation, and integration of payload requirements and to serve as the focal point for the payload community in dealing with the carriers on interface matters. • To help the user to get his requirements properly included in planning. • To assure the operating plans and forward planning of the various NASA centers with respect to utilization of the Space Transportation System are mutually compatible. • To maximize utilization of the STS while minimizing inventory. • To provide visibility for overall NASA program planning. • To recommend compatible grouping of payloads for flight. • To maximize STS utility and assure payload interface requirements are accommodated in a timely manner. • To minimize total system cost.

*A concept for SUP was furnished by the Government as a baseline for the study.

Section 2
STS UTILIZATION PLANNING

2.1 RATIONALE

The goal of the STS is to provide convenient and economical access to space. The SUP process is designed to assist in the achievement of this goal by enabling the STS to furnish rapid-response transportation even though many of the associated activities require long-lead-time planning and procurement.

The purpose of the SUP process is to perform long-range planning that anticipates traffic and provides the guidance necessary to plan the operations in detail. Six specific items were identified as requirements in this context (Table 2).

The first item is a catalog of potential payloads that can be used by the NASA Centers as a basis for planning. Convenient access to information concerning these payloads also should be provided so that the Centers are all able to work from the same set of data. An easily updated data base accessible from all of the Centers is the best way to ensure that the most up-to-date information is available without developing a large and cumbersome paper system.

Long-range traffic projections are needed to establish what accommodations will be required in the future. This is particularly important for the development of long-lead-time items such as facilities and for visibility of future budget requirements. The best approach to providing this visibility is to assemble the payloads in the catalog into logical cargoes and to schedule them for agency-wide consideration.

Short-range traffic must be considered as an integral part of long-range planning. If the STS is to have a quick-response capability, a mechanism must be provided for accommodating payloads that are not identified in time to be included in the normal planning cycle. This can only be done if cargo

Table 2

RATIONALE FOR STS UTILIZATION PLANNING

- The goal of the STS is to provide convenient and economical access to space
- SUP addresses this goal by doing what is necessary to help assure agency-wide planning is done as efficiently as possible

What Does NASA Need	Why Is It Needed	How Can This Best Be Provided
A catalog of potential payloads and their description	To provide a consistent set of data for planning	By a convenient, easily updated data base system accessible to all
Long-range traffic projections	To help establish what accommodations will be needed in the future	By accumulation of payload data into cargoes for agency-wide consideration
A mechanism for quickly including payloads in upcoming flights	Accommodating short-lead-time payloads is a Shuttle objective	Through planning by providing margins and flexibility
A baseline of projected traffic for definitive planning	To assure agency-wide plans for the STS are mutually compatible	By preparing a common baseline for planning supported by analysis and updated by operations plans of the centers
Data which accurately describes each mission	Positive control of missions is dependent on how well controlled items are described and understood	By developing a common, top-level mission description from which lower-level documentation can flow
Assessment of impact of new payloads on interfaces	Interface requirements are critical to proper development of STS hardware	By examining all payload requirements on a centralized basis to derive common requirements

space has been provided. Thus, long-range planning must anticipate quick-response traffic by providing adequate cargo-space margins and flexibility to accommodate changes.

Probably the most important item needed by NASA for long-range STS utilization planning is an agency-wide baseline of projected traffic. This is necessary so that the Centers, in planning operations and procurement for the STS, can all work under a consistent set of guidelines to produce mutually compatible plans. However, mere publication of a baseline for planning does not guarantee responsible planning unless sufficient analysis has been performed to ensure that (1) the operations associated with the baseline traffic are compatible with available resources and (2) the schedule results in efficient resource utilization.

The operational concept for the STS requires definitive premission planning and, because of the cost of operations, positive control over payloads, mission parameters, and schedules. Therefore, the missions baselined for planning must be described in a manner that will provide the Centers with the information that they need to plan their activities. Furthermore, this mission information must be specific in the areas that will be placed under management control upon approval. Thus an agency-wide set of top-level mission descriptions is needed, and this set of descriptions must be structured so that it encompasses (or at least provides a basis for) the development of lower-level control documentation.

The sixth item needed by NASA for long-range STS utilization planning is an integrated assessment of the impact that the payloads included in planning will have on the STS. This is particularly important during the STS development phase. If the planned payloads are not compatible with the STS or its operations, then the best method of accommodation (change the STS, change the payloads, or develop interfacing equipment or software) must be established.

2.2 MAJOR SUP PRODUCTS (see Table 3)

The Payload Model satisfies the need for a common catalog of payloads. This model covers payloads up to 12 years in the future to give both

Table 3

SUP PRODUCTS

Product	Description	What It Provides
Payload Model*	Compilation and description of firm and 12-year projected payloads, desired launch year and orbits, data source, and sponsor	A catalog of potential payloads and their descriptions
Traffic Model*	Summary cargo manifest for each flight (12-year horizon), by year, site, payloads, orbits, STS elements needed, load factors/ margins, contingency missions, and total cost projections	Long-range traffic projections and associated cost projections
Quick-Response Flight Request	Quick-response payload description, ground and flight requirements flight opportunity analysis, accommodations plan, flight assignment and approval	A mechanism for quickly identifying candidate flights
Planning Baseline	Synposes of missions and payload projects planned over the next 6 years, contingency traffic provisions, preliminary flight schedule options and STS utilization assessments, integrated program milestones, and cost projections	A coordinated baseline of projected traffic for definitive planning whose feasibility is established
Integrated Mission Analysis and Planning (IMAP's)**	Description of the payloads and their integrated mission operations and requirements for a given cargo manifest	Data which accurately and succinctly describe each mission and can be a basis for lower-level control data
Integrated Payload Interface Requirements and Accommodations Assessment	Collective assessment of the time-phased interface requirements (to STS) of the payloads listed in the Payload Model, definition of related MMSE needed to accommodate interface	Assessment of impact of new payloads on interfaces

*These documents have been published — see TMX 64751

**IMAP's for several early Shuttle missions have already been developed

short- and long-term visibility for planning. In order to ensure that the Payload Model is as realistic as possible, inputs are requested from the NASA payload Associate Administrators (AA's) and from non-NASA STS users twice a year (January and June). These payloads are defined in a consistent manner, and information regarding them is stored in a Payload Planning Data Bank (PPDB) that is easily accessible from all of the Centers. The Payload Model is updated yearly (1) to augment the data in the current Project Approval Documents (PAD's), which identify approved NASA payloads; (2) to reflect the status of current payload projects; and (3) to incorporate new payloads approved for planning by the payload AA's.

The Traffic Model satisfies the need for a usable long-range traffic projection. It presents summary cargo manifests and preliminary mission schedules (1-year granularity) for traffic during the operational lifetime of the STS. The cargo manifests are made up from the payloads in the Payload Model. Allowance for "extra" missions to react to contingency situations and for "open" cargo manifests to accommodate emergencies and targets of opportunity are included, along with load-factor margins for quick-response payloads. Summary cost and funding projections for payloads and transportation in terms of cost per flight and non-NASA payload reimbursements are also included. The development of the Traffic Model provides the mechanism for combining and scheduling payloads to form optimum cargoes. The Traffic Model is published yearly after coordination with the appropriate AA's.

Quick-response (QR) payloads are payloads which, because of a target opportunity, program anomaly or other factors need to be flown sooner than they can be accommodated by the normal planning process. Rather than place them in a queue to wait for the next compatible flight available, the Quick-Response Flight Request is used to initiate identification of one or more suitable flights. The request is divided into three parts. Part I is the request by the user, Part II covers the results of flight opportunity analysis, and Part III is the flight assignment, which represents a commitment by the STS to fly that payload on a specific flight.

If the payload can be accommodated without impacting mission cost or schedule, the payload originator is placed in contact with the cognizant Mission Manager for approval and integration. If a flight opportunity does not exist, the payload can be put on standby for assignment as space becomes available. For payloads that impact cost and schedules, it is suggested that they be referred to a Headquarters Level I STS Utilization Review Board (SURB) which would be responsible for approving assignment of payloads to flights and flight assignments. The SURB membership should be made up of representatives from all NASA functions concerned with STS operations and should include the Payload AA's.

The Planning Baseline furnishes the information necessary to ensure that agency-wide planning is based on a common reference and that the resulting plans of the Centers for the STS are mutually compatible. A primary function of the Planning Baseline is to provide a convenient means for annual introduction of new payloads into the planning process. The baseline describes firm and projected traffic (including contingency forecasts) within a 6-year planning horizon and includes preliminary schedules and resource utilization profiles. It serves as a common point of departure and provides planning data for the organizations that must procure for, plan for, and implement the missions included in the plan. The Planning Baseline is approved by the SURB.

Integrated Mission Analysis and Planning (IMAP) documents satisfy the need for mission descriptions that can be controlled. The IMAP's provide payload and cargo definitions, system requirements and interfaces, mission parameters (trajectories, orbit descriptions, etc.), and ground and flight operations sequences and required support. The IMAP's augment the data in the PAD (which generally are not sufficiently detailed for planning) to provide mission data in support of agency-wide planning for utilization of the STS.

The Integrated Payload Interface Requirement and Accommodation Assessment document presents, on a collective basis, the requirements of the payloads listed in the Payload Model and an assessment of the ability of the STS to accommodate them. These requirements are time-phased according to the schedule data available in the Traffic Model and provide an envelope of

interface requirements imposed by all payloads on the STS. This document is published yearly in separate volumes for each major interface, e.g., Interim Upper Stage, Spacelab, and Orbiter. The document is coordinated throughout NASA and Europe (as appropriate) by the STS Payload Requirements and Analysis Group (SPRAG) and the Joint Users Requirements Group (JURG), and is validated by the STS Payload Planning Steering Group. Validated interface requirements that are common to several payloads are accommodated by the carrier (Spacelab, Orbiter, etc.) or by multiple-mission support equipment (MMSE). Unique interface requirements are accommodated by payload-peculiar interface and support equipment. The Integrated Payload Interface Requirement and Accommodation Assessment document will be maintained during STS development to ensure that a comprehensive set of payload interface requirements is being imposed. When the STS becomes operational, this document will be updated when (and if) new classes of payloads impose significant new interface requirements.

Section 3
OVERVIEW OF THE SUP PROCESS

The STS utilization planning process has been designed to satisfy the objective defined in Table 1 by performing the following functions:

- Timely accumulation of requirements for payloads and their missions and translation of these into traffic projections for the STS.
- Maintenance of a common payload/mission data base and operations baseline whose use helps assure mutual compatibility among the various Centers' detailed planning for payload activities and STS operations.
- Development, coordination, and timing of the above data such that its availability is compatible with the planning necessary to support the Government's planning and approval cycle.

To minimize the development of new planning elements to perform the above functions, the existing NASA-wide planning network and its products were used as much as possible.

3.1 ACTIVITY FLOW

The relationship of the elements of the SUP process is illustrated in Figure 1.

The SUP process starts with the accumulation of requirements from various researchers and agencies who wish to have their payloads flown by the STS. For quick-response (QR) payloads, a Quick-Response Flight Request is prepared. Upon approval, the QR payloads are referred to appropriate NASA operational elements for integration and flight. The remaining payloads are assembled into the Payload Model, which lists all payloads approved for use in planning. As new payloads are identified for inclusion

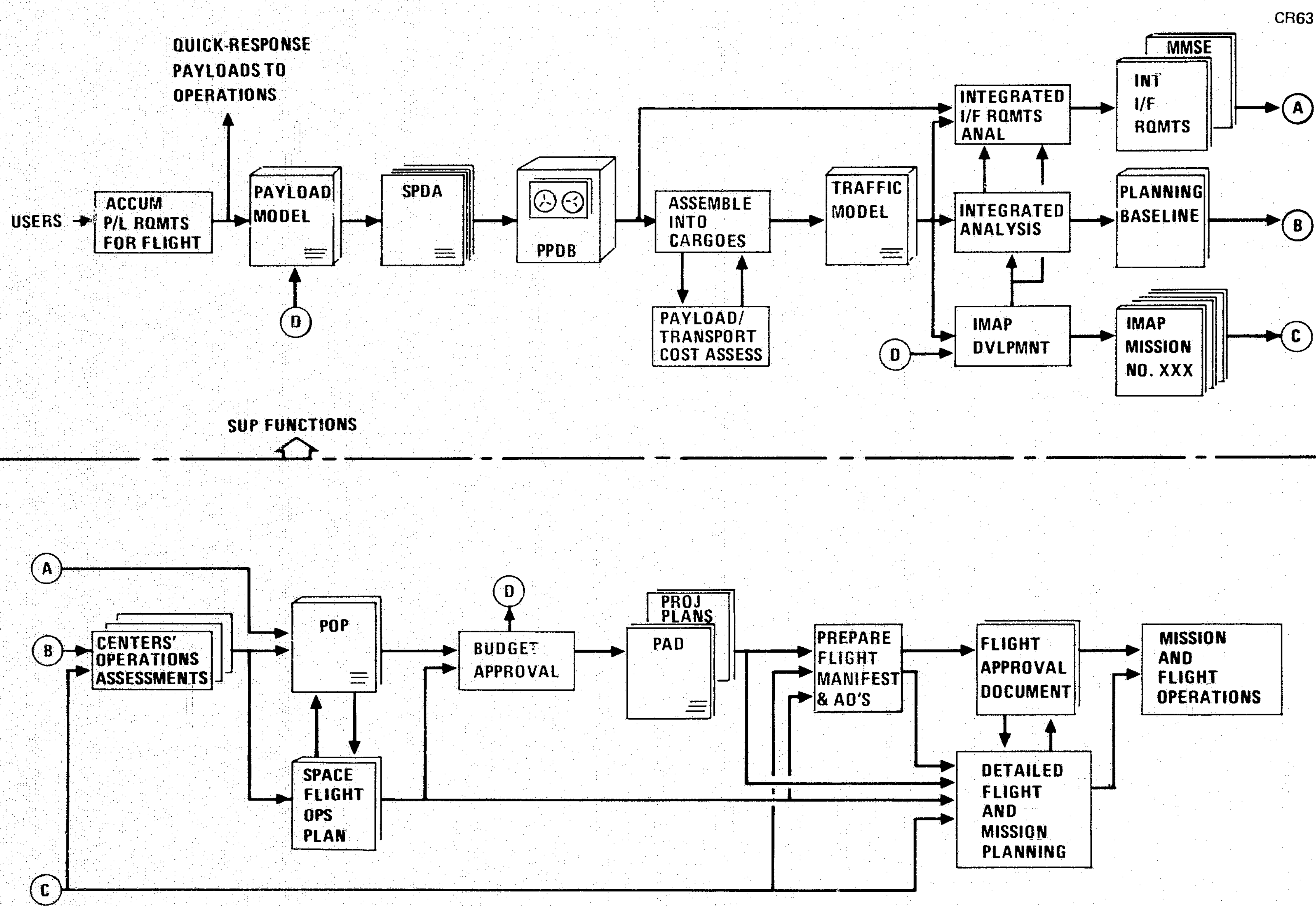

Figure 1. STS Utilization Planning Activity Flow

in planning, descriptive data for each are entered on STS Payload Data Analysis (SPDA) sheets and are included in the Payload Planning Data Bank (PPDB) accessible from the various Centers.

Cargo manifests, which consist of logical groupings of payloads and flight equipment for each STS flight, are then established. The year in which each cargo is to be flown is identified, and a cost assessment is performed that provides rough-order-of-magnitude (ROM) cost estimates for the NASA payloads and equipment and for the STS transportation costs assigned to each payload (NASA and non-NASA). The cargo manifests and their schedules are then combined with the cost assessments and published as the Traffic Model. The Traffic Model provides visibility with respect to anticipated traffic and corresponding costs to NASA for the operational lifetime of the STS.

For the payloads in the Traffic Model, the data in the PPDB are used to develop (or update) the Integrated Payload Interface Requirements, which present the envelope of payload-to-STS interface requirements to be imposed on the STS. For requirements that cannot be readily accommodated by modifying the current configuration of the STS or the payloads in the PPDB, an MMSE Plan is prepared that describes the support equipment projects needed to provide interface "bridges."

For new cargoes identified in the Traffic Model, an IMAP document is prepared. The IMAP establishes mission feasibility and describes the payloads and their integrated mission operations and requirements for individual STS flights. The IMAP also provides a preliminary definition of items to be covered by Level I control.

The traffic within the 6-year planning horizon is then assessed to determine its impact on STS flight schedules, resource utilization, key program milestones, and NASA cost projections. This is done only to the level necessary to (1) assess the compatibility to project schedules and the feasibility of the STS supporting them and (2) to show how this traffic can be accommodated within resource constraints and Headquarters guidelines. The traffic and transportation requirements, the preliminary flight schedule options, the

resource utilization assessments, and the integrated program milestones and cost projections become the SUP Planning Baseline. When approved by Headquarters, the Planning Baseline serves as a common point of departure and reference for detailed planning throughout the Agency emphasizing long-range aspects and supported by analyses sufficient to ensure that it embodies an achievable set of requirements.

The Centers use the Planning Baseline and the Program Operating Plan (POP) guidelines provided by NASA Headquarters to perform their detailed planning for payloads and operations. This activity results in the Centers establishing the POP's necessary to support the traffic projections in the Planning Baseline. The plans for STS operations that are developed to support the POP's, when integrated, become the Space Flight Operations Plan,* which is defined by JSC as the NASA Agency-wide "umbrella" for operations planning and (1) describes how the STS will support the projected traffic, (2) presents the flight schedules, (3) defines STS resource utilization, and (4) identifies STS procurement and development requirements. Any discrepancies that are revealed in the POP process are rectified in the next year's issue of the Planning Baseline. The "horizon" of the Planning Baseline is set at 6 years so as to extend past that of the POP (5 years). Thus, new, long-range requirements entering the planning can be assessed and updated at least once before they entered the POP, and then could be iterated yearly to bring them within guidelines by the time firm budgets were required.

The NASA budget request is made up from the POP's. When the primary payload projects associated with a mission are approved by a means of a Project Approval Document (PAD), a Mission Manager is selected. He translates the Cargo Manifest and IMAP for his flight into a Flight Manifest that summarizes the items on his flight that are under Level I and II control. When detailed flight planning has matured, he prepares a Flight Approval Document that summarizes the technical, programmatic, and safety data necessary to secure flight approval.

*The Space Flight Operations Plan is a 5-year horizon "work-to" plan proposed by JSC. It is assumed to be the major interface from the SUP long-range planning activities to the STS operators' planning efforts.

3.2 ACTIVITY SCHEDULING

A primary function of the SUP process is to provide a convenient means for introducing new requirements so that Agency-wide planning for operations is comprehensive and current.

Planning of operations covers a 5-year span and is documented in a Space Flight Operations Plan. Two years in advance, integrated operations support planning for authorized flights commences and becomes more detailed as time to lift-off decreases. The culmination of STS Utilization Planning is the Planning Baseline which provides the data to initiate this process. The Baseline's horizon extends beyond that of the Space Flight Operations Plan so that planning for new payloads can be iterated yearly. Long-range plans that exceed fiscal limits can thus be brought within guidelines by the time firm approval is required. The Planning Baseline, by "leading" the Space Flight Operations Plan, also provides the long-range visibility of space flight operations planning that is necessary to accommodate contingencies, changes, and quick-response payloads.

In order for the SUP process to provide the baseline information necessary for Agency planning, its activities must be compatible with each other and with the NASA POP cycle and the Federal government's new fiscal timetable. SUP activities are scheduled to support these cycles and to provide appropriate lead time to react to decisions (or problems that are uncovered) in the approval cycle. In general, the SUP process provides sufficient planning lead time in these cases such that resultant requirements for change do not have to be picked up until next year's round of planning. However, the timing of SUP activities does not preclude reaction within the current planning cycle if necessary.

Figure 2 illustrates the timing of the Government's fiscal cycle, current NASA Headquarters timing of related activities (with SUP approvals added), and the interfacing SUP schedule. For the purpose of discussion, a single SUP cycle will be described with the related events denoted by the closed triangles (▲). This cycle covers a 2-year period with SUP activities

CR63

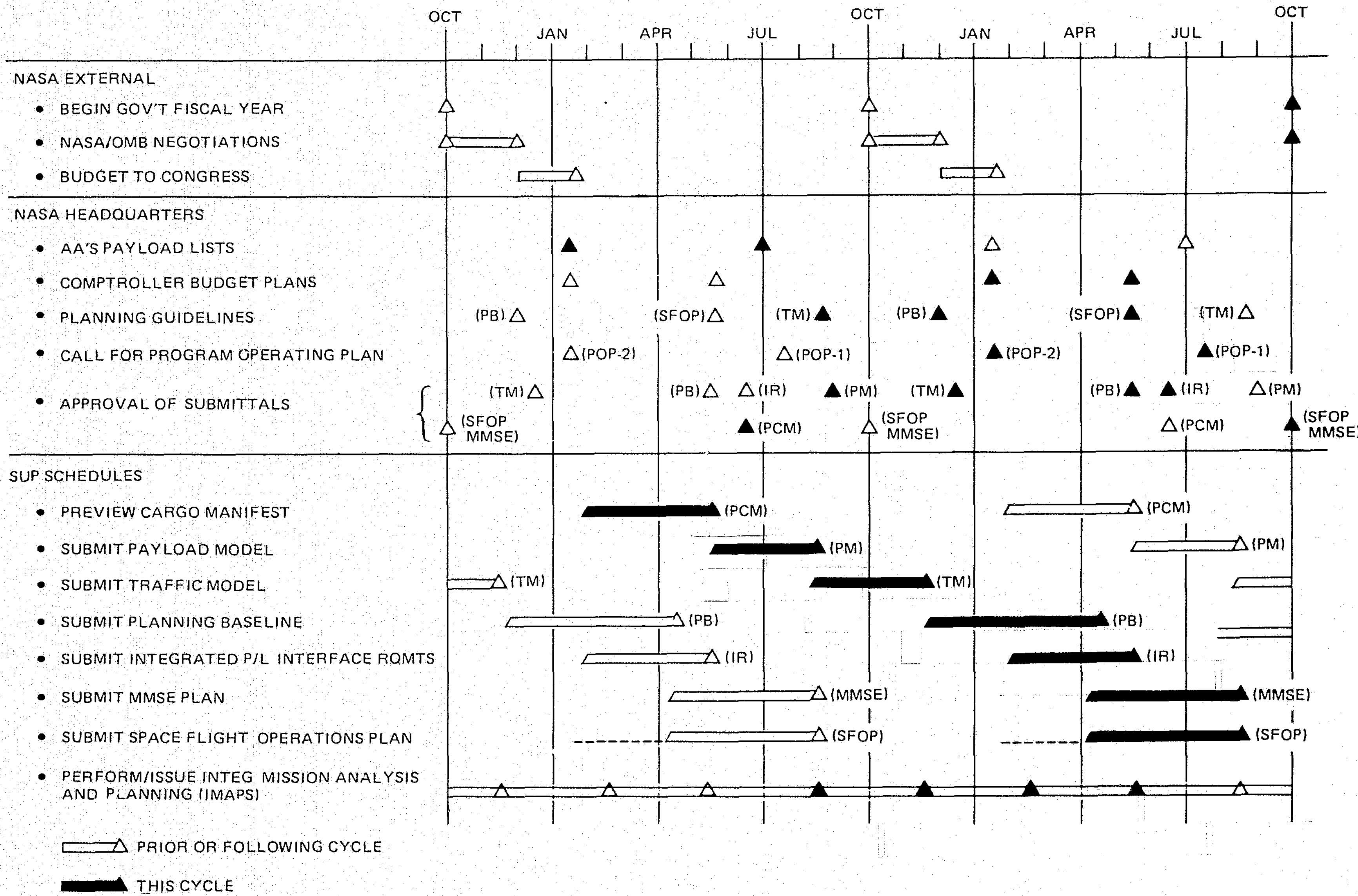

Figure 2. SUP Cycle

performed over a 20-month span* (see Figure 3), but supports a yearly budgeting cycle. As can be seen by examining the events denoted by open triangles (△) there are, at any one time, parallel SUP activities in process.

As an example, while planning for a given 6-year period is being finalized, preliminary planning which picks up the next succeeding year is already underway.**

The SUP cycle starts with the January release, by the AA's, of payload lists. These lists describe new payloads under consideration. These payloads are then added to those already in the Payload Model from the current SUP planning cycle. During the next 3-1/2 months the total set of payloads is analyzed, grouped on a preliminary basis and a "preview" cargo manifest (PCM) published in May. This PCM is tentative and is intended to provide a preliminary reference for initiating development of associated IMAP's; simulation of the process revealed that in order to prevent "spikes" in manpower loading, work on IMAP's needs to be started as soon as possible. Note that the preview cargo manifest comes out a month after the Planning Baseline for the previous planning cycle has been released. The PCM thus gives a preview of what payloads/cargoes will be added to planning subsequent to the current plan in process; if any of these payloads or cargoes are of high priority, time is still available to include them in the current plan.

---

*The analysis and simulation of the SUP process done as part of the study revealed that this time span is required to perform the required work and secure the necessary approvals.

**The simulation required development of software which would model the entire SUP process considering parallel planning activities. The simulation allowed a determination of resource requirements and exposed such things as bottlenecks and manpower peaks so that readjustment could be made to smooth out operations. Constraining operations to meet intermediate milestones also was included in the simulation to assure that the resultant SUP process is in consonance with the Government's budget and approval cycles. Because of the unique features developed in this simulation, it was reported to NASA in accordance with the New Technology clause of the contract.

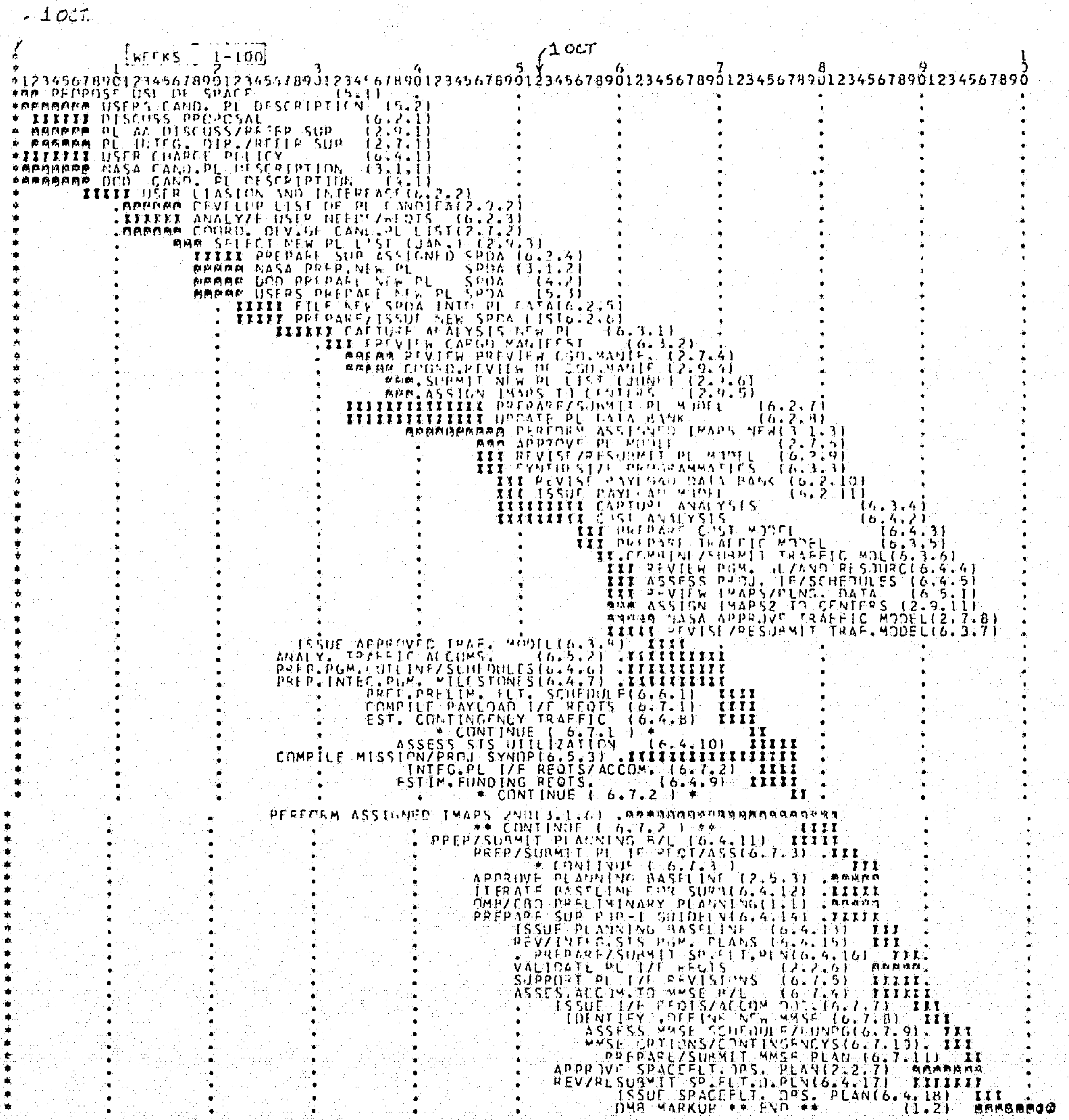

Figure 3. Sequence of Events for a Single SUP Cycle (Based on Study Simulation)

The July release of the AA's payload list and any other payloads that have been identified outside the Agency are then added to the Payload Model. Upon Headquarters approval of the Payload Model in August, and using Headquarters-furnished guidelines, 3 months are available to finalize the Traffic Model for future planning. Note that at this point the Space Flight Operations Plan of the previous planning cycle has been released to support initial budget negotiations in October.

The Traffic Model is released in mid-November and upon approval and receipt of Headquarters planning guidelines, development of the Planning Baseline is initiated. The preliminary plan and forward planning years (see Figure 4) from the plan that just entered the Government's approval cycle are updated to be consistent with the latest Traffic Model, and the new (sixth) year out at the far end of the horizon is added. This effort covers a 5-month period and is timed to accommodate information from the January POP call and budgetary planning wedges from the comptroller. It also can react to changes in forward planning in response to Congressional hearings.

The Planning Baseline is released in April for a mid-May approval. This allows the operations Centers four months to update the Space Flight Operations Plan in advance of their budget request in October. This schedule also allows time for new interface requirements to be analyzed and, if required, new MMSE identified for inclusion in budgetary planning.

3.3 QUICK-RESPONSE PAYLOAD PROCESS

Quick-response (QR) payloads are separately funded and, because they are developed on constrained schedules, are usually simple in nature and easy to integrate with the STS. (Many, in fact, are of the carry-on "suitcase" type and require only minimal support from the STS Orbiter or the Spacelab.) QR payloads are accommodated by the process illustrated in Figure 5. A QR Flight Request (Figure 6) is first initiated. The flight-request form is simple, yet when SPDA sheets are attached, it contains all information necessary to approve the payload for a flight and to document the approval. Upon completion of the Part I of the form and Level A SPDA sheets a

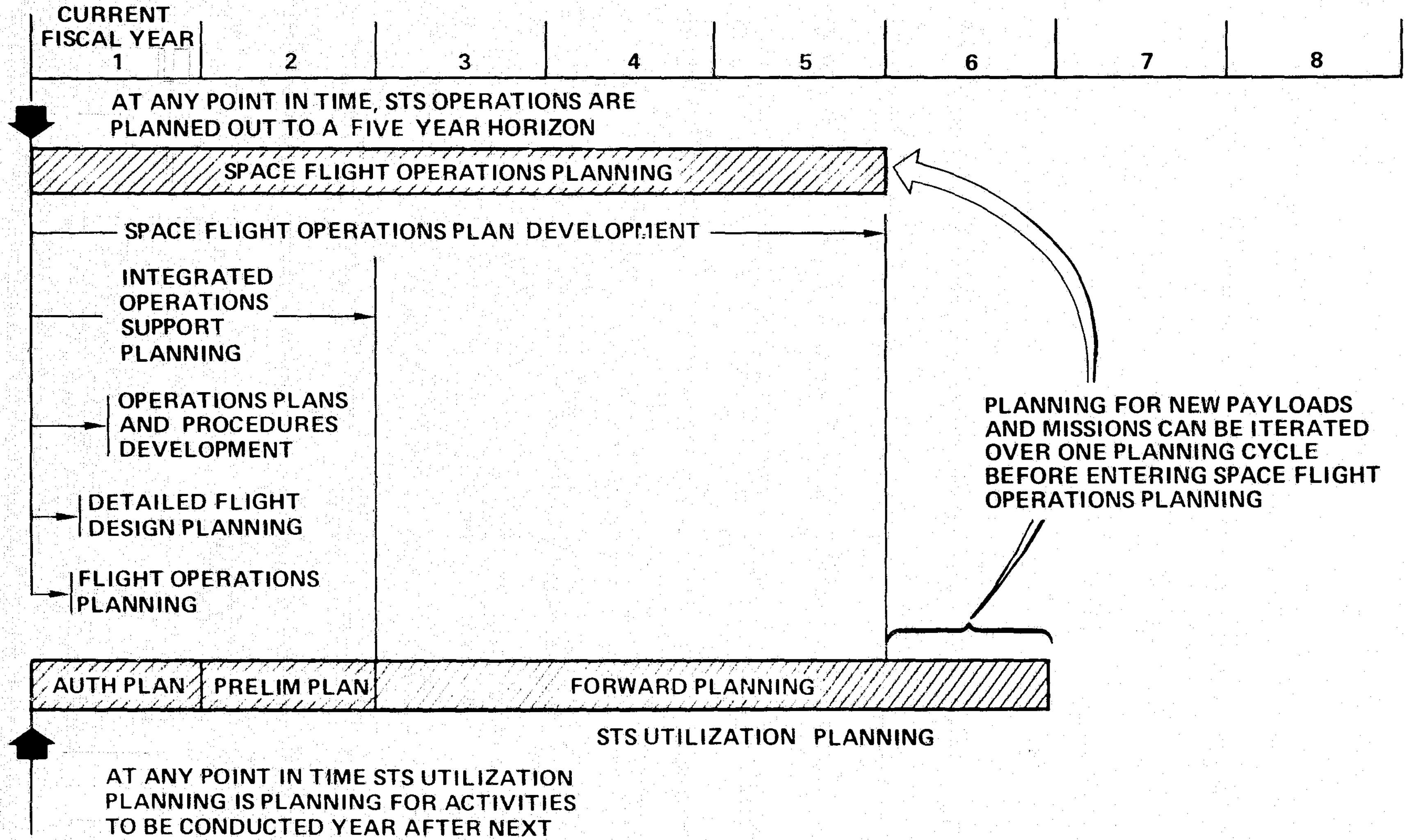

Figure 4. Overlap of STS Utilization Planning and Space Flight Operations Planning Horizons

CR63

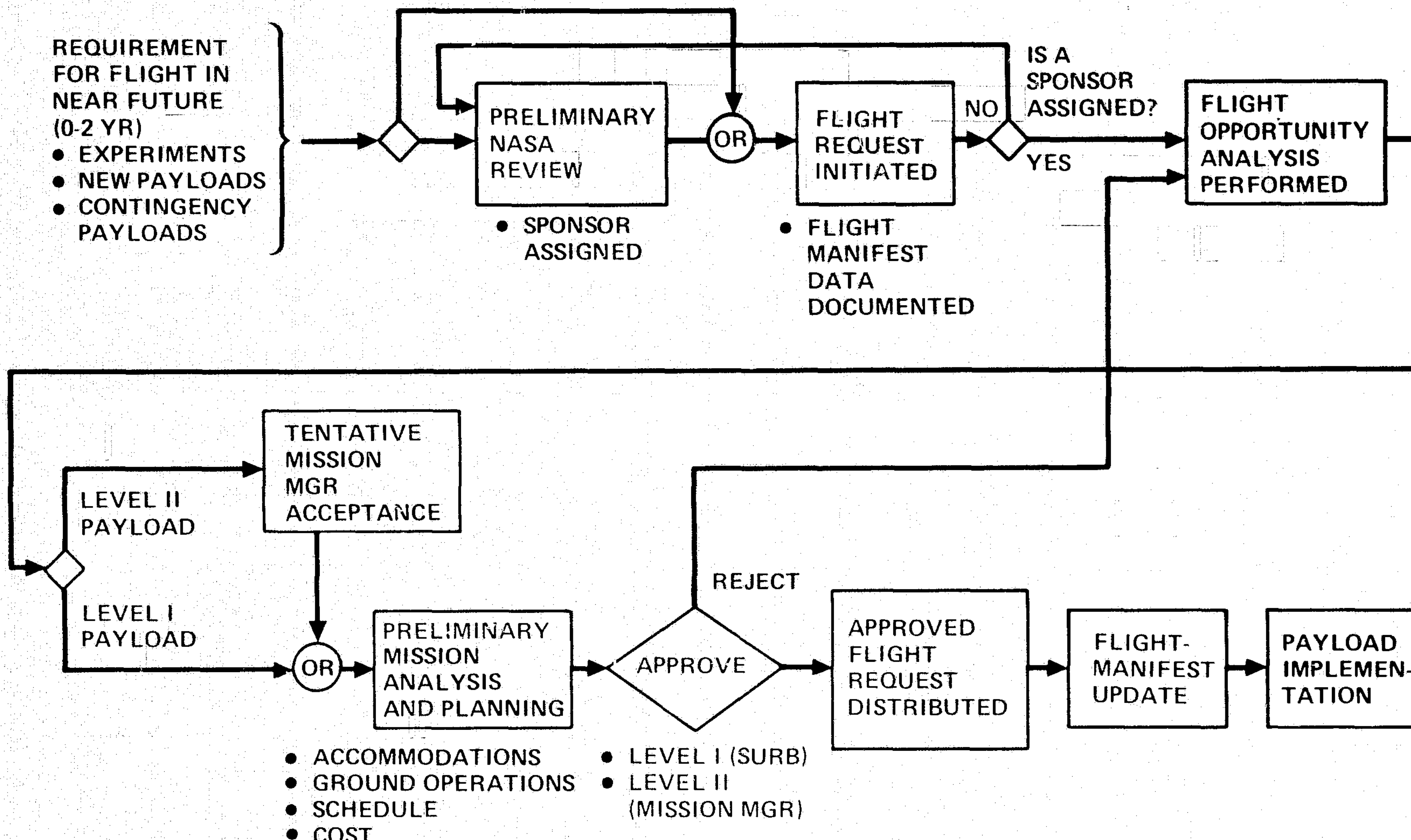

Figure 5. Quick Response (QR) Traffic Coordination

QUICK RESPONSE PAYLOAD ______ DATE ______

PART I FLIGHT REQUEST

A. PAYLOAD IDENTIFICATION
TITLE ______
OWNER ______
SPONSOR ______
CURRENT STATUS ______

B. REASON FOR REQUEST – JUSTIFICATION

C. NASA LIAISON/SPONSOR

D. SUMMARY DESCRIPTION (ATTACH COMPLETED SPDA-LEVEL A FORMS)

E. REQUIREMENT SUMMARY (ATTACH COMPLETED SPDA-LEVEL A FORMS)
FLIGHT DATE(S) ______
MISSION TYPE ______
BASIC SERVICES ______

F. SPECIAL REQUIREMENTS

1. REQUESTED PRIORITY LEVEL

REQUESTOR ______

QUICK RESPONSE PAYLOAD ______ DATE ______

PART II FLIGHT OPPORTUNITY ASSESSMENT (SHEET 1 OF 2)

PAYLOAD TITLE ______
NASA LIAISON/SPONSOR ______

A. CANDIDATE FLIGHT (ONE FORM PER OPTION)

FLT NO	FLT DATE	DURATION	ORBIT	MISSION MANAGER

B. ACCOMMODATIONS SUMMARY (ATTACH COMPLETED LEVEL B SPDA SHEETS)
PROPOSED LOCATION ______
LAUNCH/RECOVERY ORIENTATION ______
DEPLOY ORIENTATION ______
POWER PROVISIONS ______
ECS PROVISIONS ______
DATA AND CHECKOUT ______
FLUIDS AND GASES ______
STRUCTURAL SUPPORT ______
CREW SUPPORT ______

OPERATIONS
LOADING/INTEGRATION ______
DEPLOYMENT/ACTIVATION ______
RECOVERY/REMOVAL ______
OTHER ______

QUICK RESPONSE PAYLOAD ______ DATE ______

PART II. FLIGHT OPPORTUNITY ASSESSMENT (SHEET 2 OF 2)

C. IMPACT ASSESSMENT

IMPACT \ SYSTEM	STS	PAYLOADS	OTHER
COSTS			
SCHEDULES			
SAFETY			
CONTAMINATION			
EMI			
OTHER			

REMARKS

D. STS REQUIREMENTS DEVIATIONS

E. APPROVAL

REQUESTOR ______
SPONSOR ______
SPONSOR APPROVAL FOR SUBMITTAL ______

QUICK RESPONSE PAYLOAD ______ DATE ______

PART III. FLIGHT APPROVAL

PAYLOAD TITLE ______
NASA LIASON/SPONSOR ______

A. ASSIGNED FLIGHT(S)

FLT NO	FLT DATE	OR P/L PRIORITY	LAUNCH SITE ON DOCK	FLIGHT MANAGER

B. COST ALLOCATION/CHARGES
(AMTS AND DATES)

ITEM	COSTS	CHARGES	BILLINGS (ORGANIZATION)

C. APPROVALS

LEVEL II ______
MISSION MANAGER

LEVEL I ______
SEC – STS UTILIZATION REVIEW BOARD

D. ACKNOWLEDGEMENT ______
ASSISTANT ADMINISTRATION PLANNING AND PROGRAM INTEGRATION

E. ACCEPTANCE ______
DIRECTOR – STS OPERATIONS

Figure 6. Quick-Response Flight Request

sponsor (an individual within NASA who can help the payload originator progress through the approval cycle) is designated by an appropriate center representative of the Office of Planning and Program Integration (OPPI) a flight-opportunity analysis performed and Level B SPDA sheets are then prepared. These data are then submitted for approval. When the flight opportunity analysis has identified a suitable flight, space is tentatively reserved, and if the payload does not impact mission costs or schedules, the payload originator is put in contact with the flight's Mission Manager for approval and integration of the payload into the mission. The OPPI is notified of the assignment, and when the payload is accepted and approved by the Mission Manager, the flight manifest is updated. If a flight opportunitydoes not exist but the schedule permits waiting for space and/or mission time to be vacated by another payload that fails to meet its schedule, the quick-response payload owner is directed to the Director of STS Operations who can accept the payload as a standby option.

If a quick-response payload involves changes to STS costs or schedules, or if the schedule can only be met by preempting an existing flight assignment, the requirement for flight is referred to the STS Utilization Review Board, which maintains Level I control over the flight manifests. The SURB approves (or disapproves) the requirement and STS operations organizations are notified of the final arrangements. As before, if no suitable flight can be found for a QR payload it can be handed off to the Director of STS Operations as a standby option.

sponsor (an individual within NASA who can help the payload originator progress through the approval cycle) is designated by an appropriate center representative of the Office of Planning and Program Integration (OPPI) a flight-opportunity analysis performed and Level B SPDA sheets are then prepared. These data are then submitted for approval. When the flight opportunity analysis has identified a suitable flight, space is tentatively reserved, and if the payload does not impact mission costs or schedules, the payload originator is put in contact with the flight's Mission Manager for approval and integration of the payload into the mission. The OPPI is notified of the assignment, and when the payload is accepted and approved by the Mission Manager, the flight manifest is updated. If a flight opportunitydoes not exist but the schedule permits waiting for space and/or mission time to be vacated by another payload that fails to meet its schedule, the quick-response payload owner is directed to the Director of STS Operations who can accept the payload as a standby option.

If a quick-response payload involves changes to STS costs or schedules, or if the schedule can only be met by preempting an existing flight assignment, the requirement for flight is referred to the STS Utilization Review Board, which maintains Level I control over the flight manifests. The SURB approves (or disapproves) the requirement and STS operations organizations are notified of the final arrangements. As before, if no suitable flight can be found for a QR payload it can be handed off to the Director of STS Operations as a standby option.

Section 4
DEFINITION OF THE SUP SYSTEM

4.1 PRODUCT DEVELOPMENT

The SUP system assembles the data needed for planning and processes it for yearly publication in appropriate documents (Table 4). The majority of these documents have been published in the past (e.g., Payload Model, Traffic Model, Interface Requirements, and IMAP's). In the future, the SUP system will synchronize the development and publication of these documents so that they support coordinated planning for the STS. SUP itself has been designed to be synchronized with the current NASA Program Operating Plan (POP) planning and budgeting cycles and the NASA Payload List releases in January and June of each year, and utilizes these as basic inputs to its planning process.

An important tenet of the SUP study was that development of new documentation should be minimized, and that where documentation was necessary, current or planned documentation should be used if possible. In this sense, the existing Payload Model and Traffic Model, slightly enhanced, are incorporated into the STS utilization planning process with scheduled annual updates and approval cycles. The existing IMAP reports are further defined, placed into the context of the SUP process and cycle, and related to mission planning, approval, and control. Payload interface requirements documents are defined and related to validation procedures and to the generation of STS impacts (RID's and ECR's) and to the MMSE Plan.

The Quick-Response Flight Request is a new item, but it is very brief and simple. The Flight Manifest and Flight Approval Document are new, but are essentially abstracts of the IMAP and other control documents. The Flight Manifest and Flight Approval documents, while identified in the SUP study, are not part of the SUP process itself, but rather are part of the mission implementation and control process.

Table 4

STS UTILIZATION PLANNING RELATED ELEMENTS AND PRODUCTS

Planning Elements	Products	Product Description	Existing or Under Development	New
Accumulation and Maintenance of Payload Descriptions and Requirements for Flight	Payload Data	All payloads which have been approved for use in planning STS activities	o	
	STS Payload Data Analysis (SPDA) Sheets	Detailed descriptions of payloads in the payload model used as a standard payload reference for agency-wide planning	o	
	Payload Planning Data Bank (PPDB)	Centralized "library" of payload data accessible from all centers	o	
	Quick Response Flight Request	A simple form used to get a flight assignment and approval for a quick response payload		o
Interface Requirements and Accommodation Assessments	Integrated Payload Interface Requirements	Presents the envelope of interface requirements (payload to STS) for payloads in the traffic model. Imposes accommodation requirements on the STS	o	
	Multiple Mission Support (MMSE) Equipment Plan	A definition of support equipment needed to satisfy integrated interface requirements which cannot be more readily accommodated by modifying the current STS configuration or individual payloads	o	
Traffic Model Development (Capture/Cost Analysis)	Cargo Mainfests	A logical grouping of payloads and flight equipment for a single STS flight	o	
	Cost Assessment	Rough order of magnitude (ROM) estimates of the cost of (1) payloads in the cargo manifests and (2) their transportation. The ROM costs are used to evaluate scheduling of cargo manifests with respect to cost guidelines.	o	
	Traffic Model	Cargo manifests and their schedules coupled with the cost assessment. Provides visibility with respect to anticipated traffic for the operational life time of the STS	o	
Development of Mission and Flight Descriptions and Control Data	Integrated Mission Analysis & Planning (IMAP) Document	A description of the payloads and their integrated mission operations and requirements for individual STS flights. Establishes mission feasibility and provides a preliminary definition of items to be covered by Level I and Level II control.	o	
	Flight Manifest	A compilation of Level I and Level II control data for an individual payload flight.		o
Integrated Planning	Planning Baseline	A summary of payloads and their transportation requirements within a six-year planning horizon with preliminary schedules and resource utilization profiles consistent with budgetary guidelines. Provides a standard guide with respect to what payloads, missions and flights are new (or modified) in the STS planning data base (and serves as a common point of departure and reference for detailed planning throughout the agency.		o
	Space Flight Operations Plan	An integrated summary of the plans developed by operations centers in response to the planning baseline. Serves as the master operating plan for the director of STS operations	*	
Approval of Payloads Flight and Supporting Activity	Program Operating Plan (POP)	Identifies fiscal operating plans and requirements for new and continuing projects	o	
	Project Plan	The planning document which describes the overall plan for proceeding with a project	o	
	Project Approval Document (PAD)	The control document by which new projects are approved in NASA	o	
	Flight Approval Document	The control document by which individual flights are approved		o

*Proposed by JSC

The Planning Baseline, which contains the requirements for Agency-wide planning, is the only major new document specifically generated for the SUP process.

The activities described in this section are oriented toward developing the planning information necessary to accommodate payloads that are under the jurisdiction of NASA. Non-NASA payloads are handled by the SUP process in terms of their interfaces with the planning cycle and the Space Transportation System.

4.1.1 Development of the Payload Model and Payload Planning Data Bank

With the assistance of the NASA Associate Administrators, longer-term payloads that are projected but not funded are surveyed twice a year (in June and January) to identify those that are most likely to materialize as firm commitments. These "most probable" payloads are added to the list of payloads and flights that are already authorized and funded as the result of the previous planning-and-budgeting cycles and payloads originating with non-NASA sources such as the Department of Defense and the Communications Satellite Corporation.

The payloads whose milestones fall outside the 6-year horizon are also surveyed to identify those which should be considered for future planning.

All of the above payloads (except for the quick-response variety) are included in a Payload Model which is updated annually in August. The preliminary version of the model is sent to the Office of Planning and Program Integration (OPPI) at NASA Headquarters, which coordinates it for revision and approval.

For the payloads in the approved Payload Model, STS Payload Data Analysis (SPDA) sheets are developed by the payload centers. These SPDA sheets provide detailed descriptive data for each payload. When the SPDA's are forwarded to SUP by the centers, they are added to the Payload Planning Data Bank (PPDB) for use in further analyses and for access by the various centers. By this means, the PPDB provides a payload "library" service for the agency.

4.1.2 Development of the Traffic Model

Development of the Traffic Model begins with capture/cost analyses. The capture analyses compare payload accommodation requirements and orbital-activity demands (launch window, retrieval, servicing schedule, etc.), for the payloads from the approved Payload Model, with STS capabilities.

The objective of capture analysis is to assemble mutually compatible payloads into cargo sets according to various criteria such as maximizing the utilization of available STS volume and weight carrying capabilities while minimizing the number of flights needed to deliver (and service or retrieve) these payloads.

The results of the capture analyses are combined with SPDA data to produce a set of cargo manifests that assemble the payloads in compatible flight combinations for tentatively identified mission years for the operational life span of the STS.

These cargo manifests are published twice a year. In order to provide adequate lead time for mission analysis efforts, a "preview" cargo manifest is released in the spring (mid-May) based on the January payload survey. The appropriate payload centers then initiate preparation of IMAP's for new cargoes. The "final" cargo manifests for an individual planning cycle are presented in the Traffic Model published in mid-November and are substantiated by the IMAP's developed in the interim. The final cargo manifests also pick up any new payloads identified for the first time in the June payload survey and published in the August Payload Model. These new payloads are grouped into new or redefined cargoes, which, in turn, lead to assignments for new or reassessed IMAP effort for their substantiation on an "as-completed" basis.

Development schedules or procurement milestones and related funding requirements are estimated for each payload included in the cargo manifests so that the requirements of the payload traffic can be compared against budgetary guidelines. Cost estimates and schedules for approved NASA payloads are throughput from the responsible Center or extracted from the appropriate Project Approval Document (PAD). It is possible that payloads

and flights that are just entering the planning horizon might result in forecasts exceeding guidelines. However, with yearly iteration, it is expected that the plan will fall within the guidelines as it incorporates the items for which firm budget requests are forthcoming.

The cost data reported out of capture/cost analysis also include "STS cost per flight" dollars allocated to each payload. The STS cost per flight allocations, when summed, provide an indication of the total STS operations cost for the payloads included. For non-NASA payloads, these costs are separately identified as estimated reimbursements (actual reimbursements are determined later per User Charge Policy negotiations for firm payloads).

The complete set of cargo manifests and schedules (including those for approved cargoes and flights) when combined with the cost estimates for NASA payloads and STS operations constitutes the Traffic Model. Because it is critical to the future success of STS operations, that portion of the Traffic Model involving forecasted payloads must represent the best estimate possible, and the realism of scheduling and costs must be assured. Therefore, the payload schedules and costs are reviewed by the payload AA's while capability projections and costs for the STS and its support elements are reviewed by the STS Operator. Non-NASA payload organizations also review the model with respect to their payloads' schedules and interfacing milestones and cost estimates.

4.1.3 Development of Mission Requirements

When the Preview Cargo Manifest is published, the appropriate AA's assign responsibility for performing mission analysis for the various cargoes to the appropriate payload centers. In the case of the multidisciplinary missions, responsibility for mission analysis is assigned by the office of Planning and Program Integration. Since the missions under consideration are generally not approved, no mission manager has been assigned. However, an individual is assigned the responsibility to pull the missions requirements together as a surrogate mission manager. The mission analyses define the payloads for each cargo and establish the feasibility of its overall mission by resolving any incompatibilities. The results of mission analyses are

presented in the form of an IMAP document which presents a description of the mission and the required STS flight (or flights, in the case of retrieval and servicing).

4.1.4 Development of the Planning Baseline

In the STS utilization planning process, the operations centers require specific data to support their long-range planning efforts and development of their future operational budget requirements. In order to accomplish this, the centers need an authoritative list and schedule of cargoes to be flown along with specific payload and mission data as noted in Table 5*. The Traffic Model, SPDA's, and IMAP's can provide the specific payload and mission data. However, before using the data in these documents, the ability of the STS to accommodate the projected traffic and its requirements must be assessed; if there are incompatibilities, the associated technical or programmatic problems must be pointed out so they can be resolved either in the current planning cycle or, for newly emerging payloads at the far end of the planning horizon, in subsequent (yearly) iterations. This includes assessments for contingency and quick-response traffic. A Planning Baseline Document is proposed which accomplishes the above. It is prepared for release in April of each year as an approved guide to enable the STS and payload organizations to achieve consistency among their individual planning efforts. Simultaneously, finalized SPDA and IMAP data for payloads and missions in the Planning Baseline are made available.

The Planning Baseline (Table 6) presents a summary of transportation requirements in the 6-year planning horizon comparing them on an integrated basis with current capabilities to establish their "achievability" (or to expose problems). Both emerging and authorized payloads and missions are accounted for. Preliminary assessments of schedule and resource utilization also are included.

---

*During the course of the study, the operations centers were surveyed to determine their needs. The Planning Baseline described in this section is designed to satisfy what was desired by the centers (on a collective basis) as an input to their planning.

Table 5

DATA NEEDED BY THE OPERATIONS CENTERS FOR LONG-RANGE PLANNING

Data Items Common to All Centers

- Traffic model/cargoes
- Mission synopses
- New payloads and missions identification
- Schedules
- Quick-response/contingency forecasts

Data Items for Specific Functions

Network Data

- Orbital parameters
- Period of support
- Type of service (MA, SSA, KSA, other)
- Return/forward/tracking period
- Data bandwidth/bit rate
- Terrestrial bandwidth/bit rate
- User receiver locations

Launch Operations Data

- Special support facilities/equipment
- Special access and PCR requirements
- Unique operations
- Hazardous operations
- Resource requirements (fluids, power, area, etc.)
- Radiation hazards
- Payload classification constraints

Flight Operations Support

- Data acquisition requirements
- Period of support
- Real time display requirements
- Off-line computation
- Uplink requirements
- Crew/skill requirements
- Simulation/training requirements
- Special facility requirements

Table 6

PLANNING BASELINE

- Payload Lists/Project Status and Schedule Summary
- Mission Synopses and Requirements Summary
- Traffic Model/Cargoes Summary
- Flight Schedules
- Contingency Traffic
- Resource Base* Utilization/Inventory Profiles and Preliminary Assessment
- Major New Starts/Projects**
- Integrated Program Milestones and Schedules and Compatibility with Budget Guidelines

*STS Elements, LRF, MCC, POC, Network
**Includes STS Projects as required by Mission and Flight Schedule

Figure 7 illustrates the activities associated with developing the Planning Baseline. During the year preceding the publication of the Planning Baseline, changes covering new, near-term payloads and flights whose milestones have moved into the 6-year planning horizon are accumulated. Inputs with respect to required open cargo manifests and margins for quick-response payloads also are accumulated. Headquarters direction is given as to which planned new payloads should be included and what priorities should be assigned, and as to the status and priorities of previously included projects and STS operations. With this data the Planning Baseline can be developed after the analyses described in the following paragraphs have been completed.

4.1.4.1 Contingency Analyses

Contingency traffic is incorporated in the Planning Baseline by estimating, through statistical evaluation of past operations and future traffic projections, the number of extra flights that must be included in planning. Forecasts from the payload organizations of additional flights that may be needed for emergencies (e.g., replacement of a failed satellite) and/or targets of opportunities also are included so that "open" cargo manifests can be provided for them. Flexibility to accommodate payload deletions, launch aborts, emergency missions (e.g., repair or replacement of a failed satellite), and

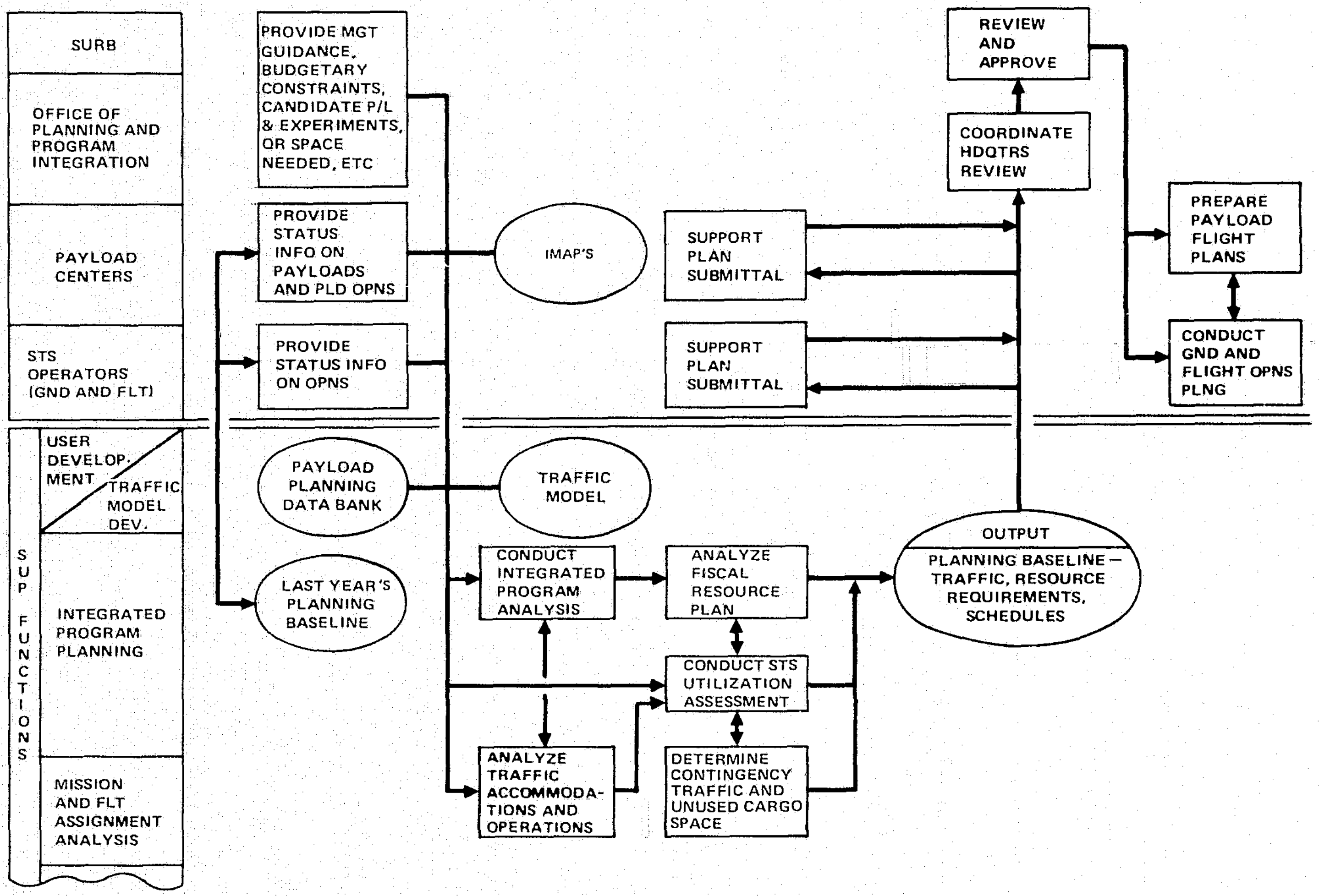

Figure 7. Planning Baseline Development

extra missions needed over and above those provided by the open cargo manifests is provided by determining and operating under an optimum utilization factor and flight schedule distribution that allows insertion and/or substitution of STS flights, as well as tolerance for "workaround" impact on the next flight or two after a contingency.

4.1.4.2 Integrated Scheduling and Utilization Assessment Analyses

Integrated scheduling analyses are also performed to provide preliminary time phasing for the utilization of the resources necessary to support the payload traffic. These analyses are based primarily on the operations flows, and timelines in the IMAP's for new missions, the respective centers' project plans for authorized missions and the standard resource and operations handbook provided by the Operations Centers (STS, LRF, MCC, NET, etc.). These analyses are coordinated with the appropriate centers to assure they present a valid picture of what will be needed and can be accommodated.

4.1.4.3 Data Sources

In order to preclude overlaying a new management planning system on the various centers, the development of the Planning Baseline is predicated on using current data which is developed by the various centers in their normal course of business.

Figure 8 summarizes the input sources which are integrated into the Planning Baseline. As can be seen, the majority of the input sources are already in existence, or are normally produced for new payloads. However, there are some new sources of data, or expansions to existing data sources, that appear to be necessary:

- Headquarters Guidelines – These guidelines are required on a semiannual basis and consist of new payloads to be included in planning, constraints, approved schedules, budgetary planning wedges, and current tariff structure.
- Spacelab Payloads Integration Plan – A control document which summarizes Spacelab payloads and their schedules, predicts contingency traffic, and estimates schedule compliance probabilities for individual payloads/experiments.

CR63

DOCUMENTS / INPUTS	PAYLOAD LISTS/PROJECT STATUS & SCHEDULE SUMMARY	MISSION SYNOPSES AND REQUIREMENTS SUMMARY	TRAFFIC MODEL/ CARGOES SUMMARY	FLIGHT SCHEDULES	PROJECT CONTINGENCY TRAFFIC	RESOURCE BASE UTILIZATION/INVENTORY PROFILES	MAJOR NEW STARTS/ PROJECTS	COST PROJECTIONS/ FUNDING RQMTS/ REIMBURSEMENTS	PROGRAM MILESTONES & SCHEDULE	BUDGETARY GUIDELINES & CONSTRAINTS
HEADQUARTERS GUIDELINES										
– PLANNING GUIDELINES							O		O	O
– AA'S PAYLOAD LISTS	*									
– POP GUIDELINES/BUDGET PLNG WEDGES										*
– FISCAL RESOURCE PLAN										*
SUP-RELATED DOCUMENTS										
– PAYLOAD MODEL, SPDA	●	●								
– CARGO MANIFESTS AND TRAFFIC MODEL		●	●	●						
– COST ASSESSMENT								●		
SHUTTLE SYSTEMS DOCUMENTS (0700)										
– PAYLOAD ACCOMMODATIONS (VOL XIV)		●								
– PROGRAM PLAN STATUS REPORTS						●	●	*	●	
– COST/FLIGHT PARAMETERS (VOL XVI)								●		
PAYLOAD PROJECT DOCUMENTS										
– PHASE A/B STUDIES	●	●	●		*		●	●		
– PAYLOAD PROJECT PLANS AND PAD'S	●	●	●		*		●	●	●	
– SPACELAB PAYLOAD INTEGRATION PLANS	O	O	O		O		O	O	O	
– IMAP'S		●			*					
SPACELAB SYSTEMS DOCUMENTATION										
– PAYLOAD ACCOMMODATIONS (SLP/2104)		●								
– PROGRAM PLAN/STATUS REPORTS						●	●	*	●	
SUPPORT OPERATIONS DOCUMENTS										
– STDN (101.1) AND TDRS (101.2) USER'S GUIDES						●		*		
– KSC STS USER'S HANDBOOK						●				
– KSC SHUTTLE PROJECTS SUMMARY (K-SM-03. 1,02.3)						*		●	●	
– JSC FLIGHT SYSTEMS SUPPORT CAPABILITY						O		O		
– POC OPERATIONS CAPABILITY						O				
ACCOMMODATION RESERVATIONS										
– STDN MISSION MODEL (STDN 816)						●			●	
– SPACE FLIGHT OPERATIONS PLAN (1)				O	O	O			O	
– SPACELAB ELEMENTS AND LOGISTICS PLAN			O			O			O	
– POC OPERATION PLANS						O			O	
– KSC SHUTTLE PROJECTS SUMMARY						*			●	

NOTE: ADDITIONAL DOCUMENTATION REQUIRED TO COVER WTR AND REMOTE RECOVERY SITES

(1) PREPARATION OF THE SFOP IS IN PLANNING BY OSF

● EXISTING DATA

* RECOMMENDED EXPANSION TO EXISTING DOCUMENTS

O REQUIRES NEW DOCUMENTS

Figure 8. Inputs Required for the SUP Planning Baseline

- JSC Flight Systems Support Capability and POC Operations Capability - Documents which provide current and projected capabilities for STS and payload mission control (how many missions can be handled in a given time period, constraints on control center turnaround time, etc.) and manpower and new equipment/equipment requirements for increased mission rates.
- Space Flight Operations Plan - The Space Flight Operations Plan has been proposed by NASA/JSC to be the NASA Agency umbrella for operations planning, including near-term missions, payloads, flight hardware assignments, schedules, and directional guidelines through 5 years. It includes the "work-to" flight schedule, an integrated operations support plan (basis of resource commitment by centers), and identifies development plans for any additions to the STS program resources.
- Spacelab Elements and Logistics Plan - A document which presents Spacelab element assignments to PI locations and STS flights, and their scheduled utilization with key milestones.
- KSC Shuttle Projects Summary Books - Should be expanded to include accommodation reservations and resource utilization profiles for approved missions.

4.1.4.4 Budgetary Planning Assessment

A basic premise of the SUP system is that all centers will conduct their individual planning to the payloads, missions, and schedules assembled in the Planning Baseline. Revisions and adjustments to the Planning Baseline are accepted from (1) the centers through their respective Associate Administrator's input to the next Planning Baseline cycle guidelines, (2) Headquarters review and approval, and (3) operation of the POP cycle and publication of the Space Flight Operations Plan. Thus, as the Planning Baseline is "stepped" (updated) each year, the forward planning years of the Planning Baseline and the Program Operating Plans/Space Flight Operations Plan of the centers are brought into agreement through this annual feedback loop.

Part of the "stepping" process is the reconciliation of the Operating Plans future funding projections with the NASA Budgetary guidelines. The August POP responses from the centers including new initiatives, as well as sustaining and runout funding requirements, are submitted through their respective AA's to the NASA Comptroller. The Comptroller uses the POP responses, along with NASA Management guidelines, for development of line item budget requests and forward (5-year) plan for negotiations with OMB each October. The individual POP future projections are compiled by the Comptroller, per NASA Management guidelines, into future budget planning "wedges" for each program office. These are associated with the new initiatives (payloads, missions, STS projects, etc.) to be accommodated in the next Planning Baseline. These new initiative budget planning wedges are keyed to the integrated program schedules and project interfaces so their total funding impacts can be assessed. The results are added to the established sustaining and runout budget and compared to the budgetary guidelines. Discrepancies are identified and planning options are developed and assessed for resolving these conflicts through project deferrals, schedule slips/stretch/acceleration, etc. These options are coordinated through the Comptroller to arrive at a fiscal resource program plan and schedule compatible within budgetary guidelines. Program guidelines and priorities provided by NASA management are used in developing and assessing the program options. Use of the approved Planning Baseline by the centers as a common program reference in preparing their individual POP should help minimize post-submittal POP reconciliation requirements.

4.1.4.5 Approval

Upon completion, advanced copies of the Planning Baseline are transmitted to the various centers for comment. At the same time it is sent up to the Assistant Administrator for Planning and Program Integration for presentation and approval by the SURB. Upon approval, the STS operations and payload centers use the plan as the basis for their individual planning. As part of this planning, the centers develop updated payload schedules, STS capability requirements and descriptions, and mission analyses. The centers also update estimates of quick-response traffic and open cargo manifest requirements. These data are then included in the center's planning

documentation which in turn then becomes an input to their POP and to next year's Planning Baseline.

4.1.5 Development of Integrated Payload Interface Requirements

As shown in Figure 9, the payloads in the Payload Model are analyzed to establish their collective requirements for interfacing with the STS, support equipment, and supporting services. The Traffic Model and associated IMAP's are used to establish interface requirements imposed on the STS as a function of time and of the combined payload requirements due to payload groupings (cargo manifests).

The integrated interface requirements are compared against the current STS and support-element configurations as defined by operations handbooks, and assessments are made to define the impacts and approaches for accommodating the requirements by changing the STS or the payload, or by developing new MMSE. This work is done under the direction of the STS Payload Requirements and Analysis Steering Group (SPRAG) and the Joint Users Requirements Group (JURG). The latter represents the European Spacelab community. SPRAG also helps to coordinate analyses and data needed from the various centers.

After reviews by SPRAG and Headquarters of the integrated interface requirements, impacts, and accommodation assessment, the Assistant Administrator for Planning and Program Integration submits the documentation to the STS Payload Planning Steering Group (SSPPSG) for validation (acceptance as being appropriate for imposition on the STS).

When interface incompatibilities are found between items being developed (such as the STS Orbiter) and the validated interface requirements that must be accommodated in the next 6 years (or requirements that need not be met until later but are deemed fundamental to the STS or MMSE element in question, and thus should be included during development), SPRAG directs the writing of a Review Item Discrepancy (RID) for presentation to the design review board responsible for the item under development. For items that have been declared operational, an Engineering Change Request (ECR) is submitted. If a RID or ECR is accepted, it is tracked as necessary to verify

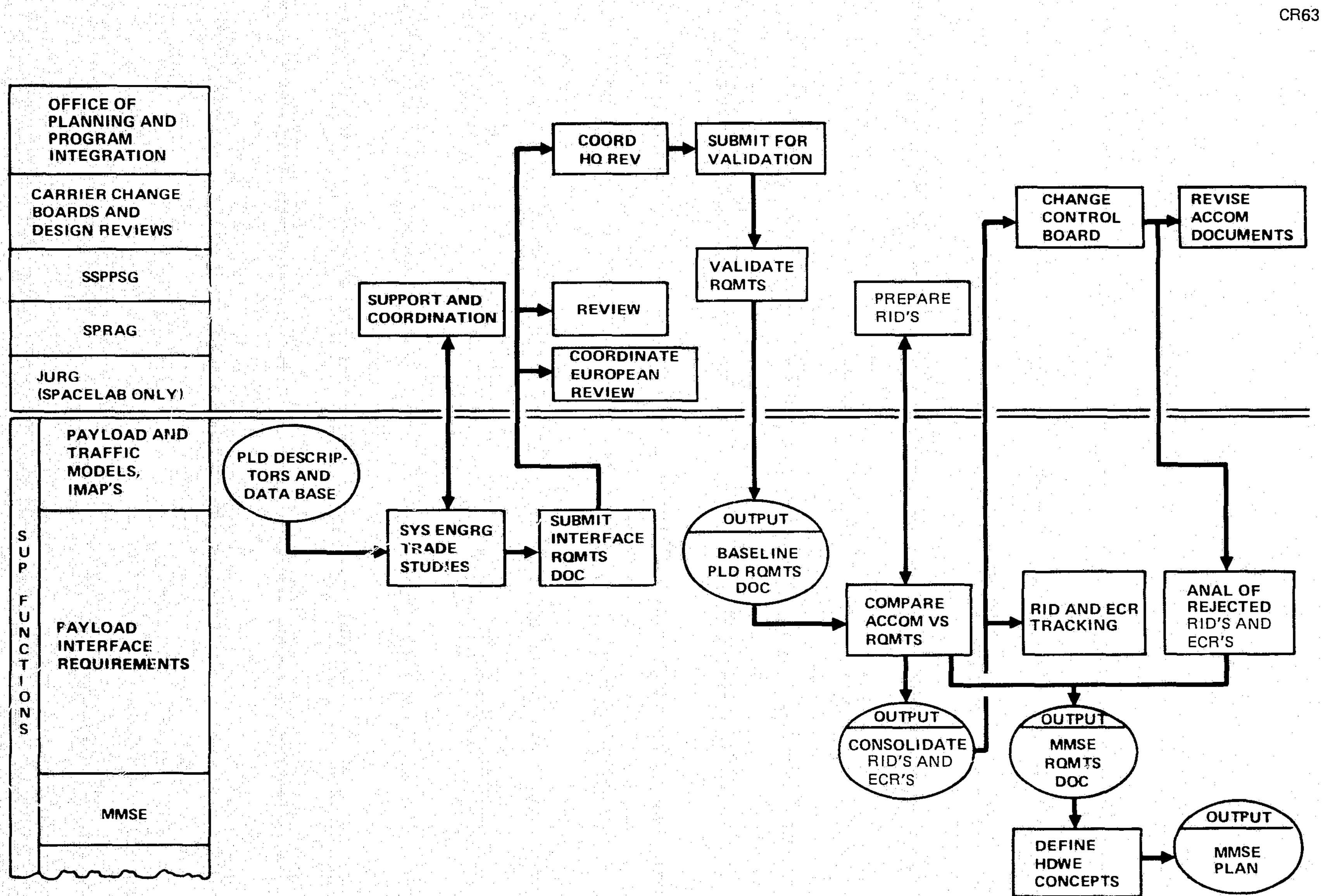

Figure 9. Analysis of Interface Requirements and Carrier Accommodations

its incorporation and establish its effectivity. The affected interface accommodation or MMSE data book is then revised and the various centers alerted to this change.

For RID's that are rejected or changes that are subsequently rejected by the Change Control Board (CCB) of the element in question, three courses of action are possible: (1) define new or modified MMSE to provide the required transition across the interface, (2) modify the payload, or (3) modify planning (i.e., regroup payload combinations that exceed STS capabilities). Appropriate analyses and trade studies are performed in conjunction with SPRAG to establish recommended solutions and the cycle is reentered through the SSPPSG. The Planning Baseline or MMSE Plan is revised accordingly and the appropriate payload organization is alerted.

4.2 SUP SYSTEM ELEMENTS

The system required to produce these products consists of a planning group, technical support services, a data system, and interfaces to the various NASA program centers (STS operations, payloads) and to NASA Headquarters.

4.2.1 SUP Planning Group

The SUP planning group is aligned to the major SUP products and functions as indicated in Figure 10. The SUP Project Management (1.1) provides management of the SUP project group as well as coordinates its activities with SUP-related activities throughout NASA and other interfacing elements (DOD, user community). User Development and Payload Model (1.2) provides the central user liaison/coordination for user requirements and requests, including quick-response requests. This also includes compilation of payload lists and payload data (SPDA sheets), including on-orbit payloads subject to revisits as well as new and planned payloads, over the planned operational lifetime of the STS. This element includes establishment and maintenance of the Payload Model each August.

Traffic Model Development (1.3) performs the preliminary definition of cargo manifests through capture analysis using payload data from the PPDB, data on the STS accommodations/capability, planned/requested payload launch (or revisit) dates (year), and guidelines and prior traffic projections on STS

CR63

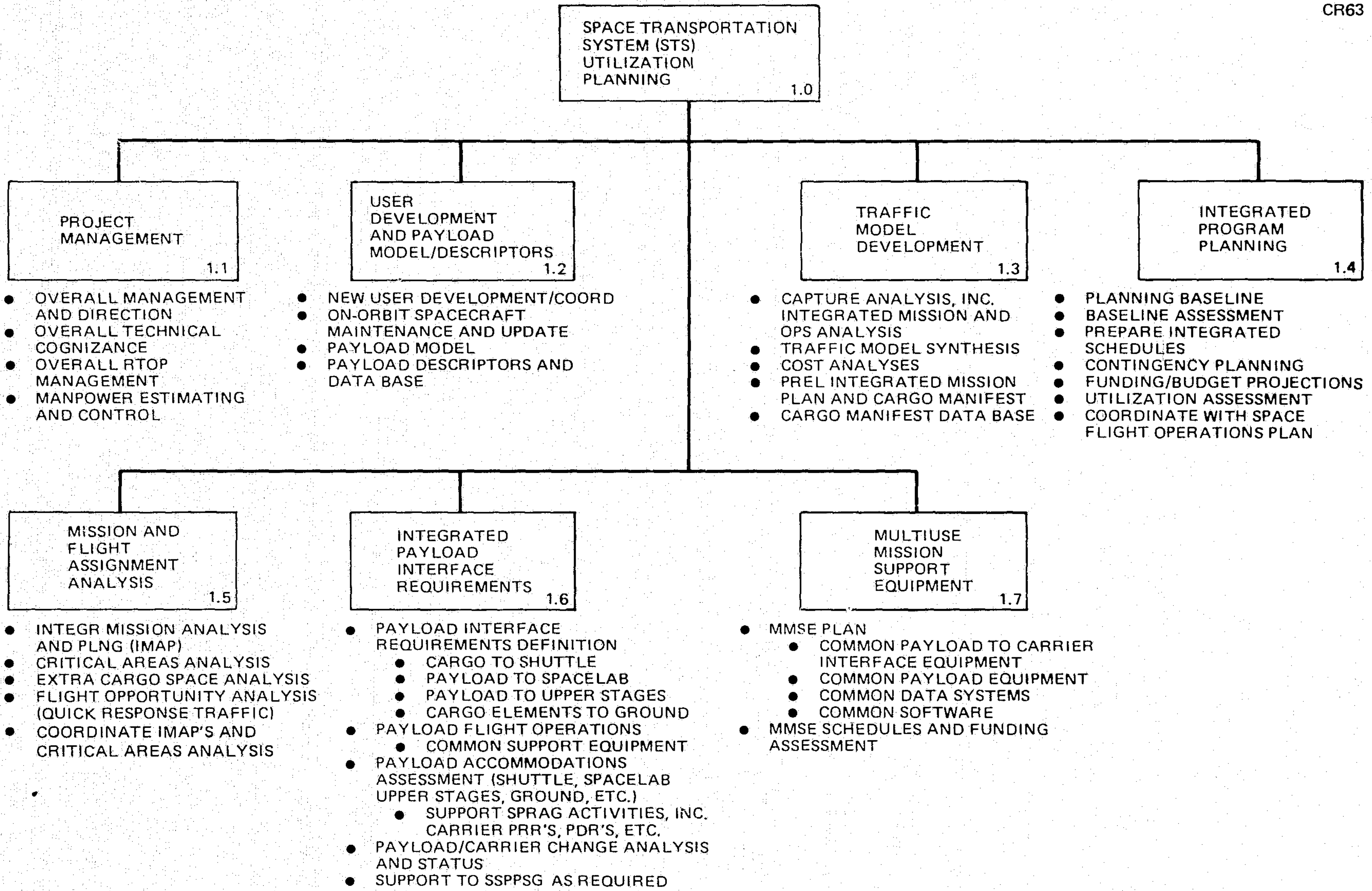

Figure 10. SUP Work Breakdown Structure

utilization (includes LRF and network). Preliminary analyses of cargo manifests are made to assess payload compatibility and the preliminary integrated mission plan/STS compatibility. An update of the cargo manifests/traffic projections is published each May as a Preview Cargo Manifest. A traffic model is developed covering the projected traffic (by year and site) over the operational life of the STS.

Cost estimates (by year) are made of the projected traffic using available data and Cost Estimating Relationships (CER's) appropriate to identify costs to NASA (NASA payloads and transportation) and to users (transportation and other NASA reimbursed charges). The costing assessments are included with the updated cargo manifests and traffic projections in the Traffic Model published each November.

Mission and Flight Assignment Analyses (1.4) assess cargo manifest compatibility in greater depth, develop preliminary integrated mission plans, and identify desirable flight dates or flight opportunities. Integrated Mission Analysis and Planning reports (IMAP's) are prepared for cargo manifests approved for preliminary planning. Most IMAP effort is performed by the assigned payload centers with SUP supporting and coordinating as appropriate. In some cases, the SUP project group may develop IMAP's directly.

This work area also includes the flight opportunity analysis/cargo margin analysis effort in support of preliminary flight scheduling and quick response requests.

Integrated Program Planning (1.5) translates the near-term portion of the Traffic Model, IMAP's data, project plans data, POP guidelines and STS operations plans into an integrated program plan as an Agency-wide common reference Planning Baseline.

This planning includes assessment of STS resources utilization, development of integrated program milestones, contingency planning, funding/budgetary projections/guidelines recommendations, and a preliminary flight schedule.

This work area includes coordination of this effort with the STS operations and support centers in support of Space Flight Operations Plan (and support plans) development.

Development of Integrated Payload Interface Requirements (1.6) draws on the PPDB and IMAP's effort to develop an envelope of payload requirements imposed on STS elements. These are assessed against the nominal accommodations and submitted to the SSPPSG for validation. This effort is performed in coordination and with the review and approval of the SPRAG and JURG.

One result of the interface requirements effort is the development and update of an MMSE Plan (1.7) which identifies requirements and utilization of MMSE along with its appropriate programmatic (schedules/funding) assessments.

4.2.2 SUP Data System

The integrated process proposed to tie together the SUP computer systems and software programs, data management (data storage, retrieval, and display systems), and reports/data production tasks is the SUP Data System. It supports the overall NASA planning process which plans and schedules the payloads to fly on the STS.

The SUP Data System provides SUP management and staff with effective computer-based support in establishing and operating the SUP process. The functional relationships between the different elements of the system shown in Figure 11 illustrate its capabilities in data processing, report generation, and handling of terminal accessible data banks. The proposed data system would utilize established NASA computer hardware and data bank capabilities, for example, the Marshall Information, Retrieval, and Display System (MIRADS) for teleprocessing activities. However, some additional automation is desirable. As an example, scheduling software that will help assess STS resource utilization (in developing the Planning Baseline) appears to be needed to efficiently meet the milestones associated with NASA's and the Government's planning and budgeting cycle.

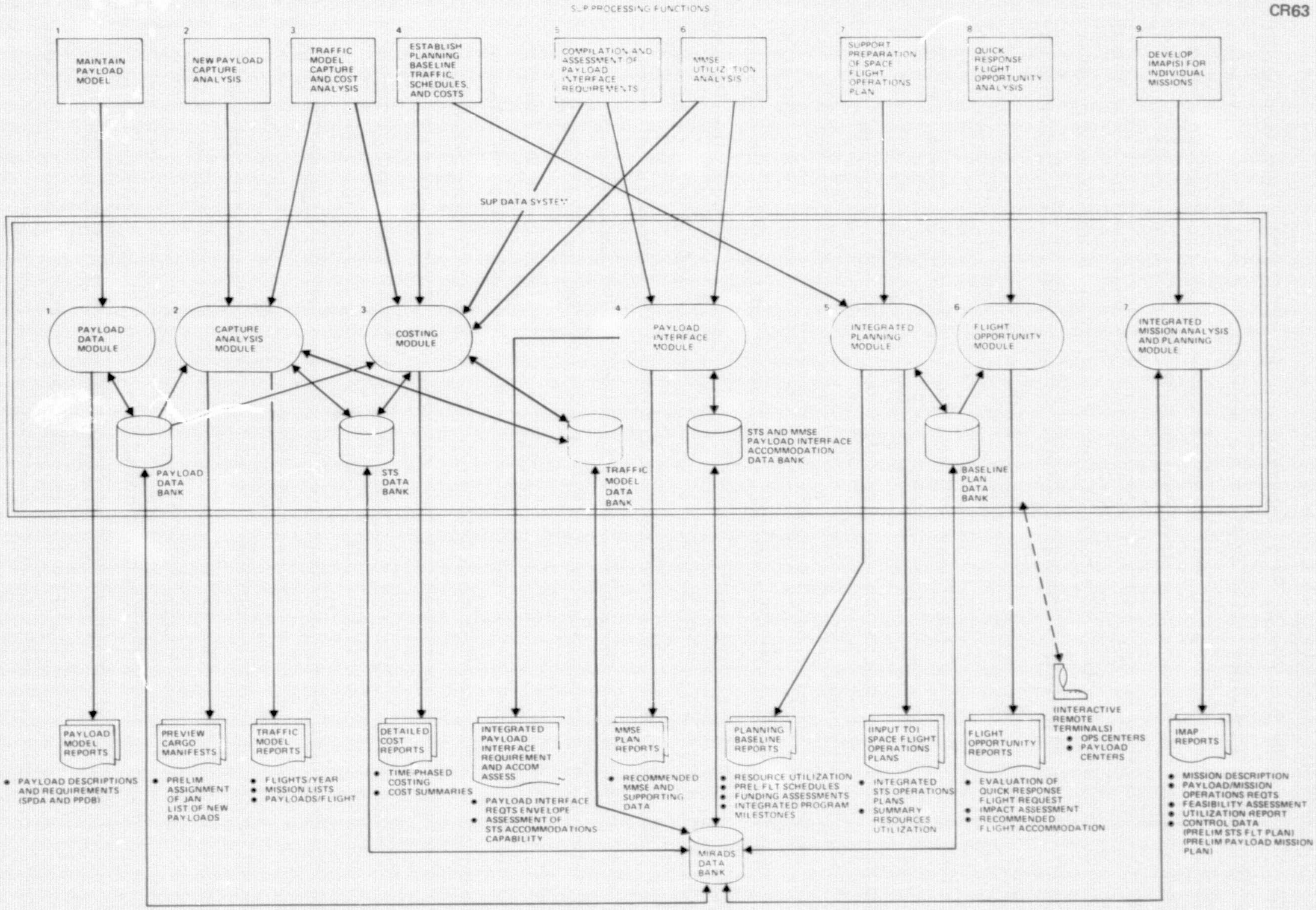

Figure 11. SUP Data System

4.2.3 Program Interfaces

In performing its functions, SUP interfaces with all NASA elements involved with the Space Transportation System as outlined in Table 7. Its interface to Headquarters is primarily one in which guidance is received and approvals are obtained. Its interface with the Payload Centers is generally associated with the collection of payload and payload mission information. The interface to the Operations Centers is more or less restricted to maintaining current information on the status, capabilities and assignment of STS elements and supporting services.

The SUP project group interfaces with the user community, DOD, and NASA payload offices for payload data, the NASA payload centers for mission planning, the NASA operations centers for STS data and operations planning, and NASA Headquarters for guidance and approval. Figure 12 indicates these interfaces and how they relate to the SUP work breakdown structure. SUP interfaces to non-NASA payloads (user community, DOD) through its Users' Liaison Office and to the NASA Payload Centers through the Payload Planning Data Bank (PPDB) Interface Module and the IMAP efforts at each center. In connection with user liaison and integrated program planning, SUP may interface directly with Mission Managers for Quick-Response Request and project planning data. SUP interfaces to the NASA Payloads Offices at Headquarters for release of approved Payload Lists in January and June of each year - this includes approval of non-NASA payloads for planning purposes, as well as NASA payloads. This interface, as well as other Headquarters interfaces, is executed through the Office of Planning and Program Integration (OPPI) which sponsors the SUP project group. This includes interface to the NASA Comptroller for POP guidelines and budgetary planning data, interfaces to the various NASA Program Offices (OSS, OA, OAST, OSF/STS Operations/STS Programs) for planning guidance and data and the coordination of Headquarters review and approvals of the Traffic Model. The OPPI also provides the SUP interfaces to the STS Utilization Review Board (SURB) for review and approval of the Planning Baseline and to the STS Payload Planning Steering Group (SSPPSG) for review and validation of Integrated Payload Interface Requirements. SUP interfaces directly with the STS Payload Requirements and Analysis Group (SPRAG) and the (Spacelab) Joint Users Review Group (JURG) on the development and review of the payload interface requirements.

Table 7

SUP FUNCTIONAL INTERFACES INTERNAL TO NASA

NASA Headquarters	SUP Function	Payload Centers	STS Operations Centers
Referral of users to SUP	Payload-user liaison and requirements	Candidate payload descriptions	
Notification by SUP of recommended assignment	Quick response flight opportunity analysis	Access SUP data base	Recommended flight assignments for QR payloads
AA recommendations. Coordinate and approvel payload model	Payload model preparation	Response to "SPDA call"	
Technical and fiscal guidelines and plans	Capture/cost analysis (cargo manifests)	Furnish summary payload program data	Furnish current and projected STS capabilities
Review and approve	Traffic model preparation (cargoes plus traffic plan)		Long-range planning
Planning guidance, review, and approve.	Planning baseline (near term)	Advise, review for input to planning	Advise; review for input to planning
Review options and select groupings	Prepare mission options (multiple users)	Advise	Advise
Responsibility assignments for missions	Coordinate integrated missions analysis	Provide integrated missions analysis (IMAP)	Provide STS accommodations, operations and capability definitions
Coordination, review, and approve	Advise and support	Advise and support	Prepare space flight operations plan
STS Payload Planning Steering Group Validation	Integrated payload requirements synthesis and SPRAG coordination	Payload interface requirements development, SPRAG support	STS accommodation descriptions/handbooks
SSPPSG validation	MMSE requirement and equipment identification	Payload interface requirements, SPRAG coordination	STS accommodation and MMSE description
SUP RID/ECR recommendations	Support RID/ECR preparation	Prepare RID's and support milestone reviews	Act on RID's and ECR's

CR63

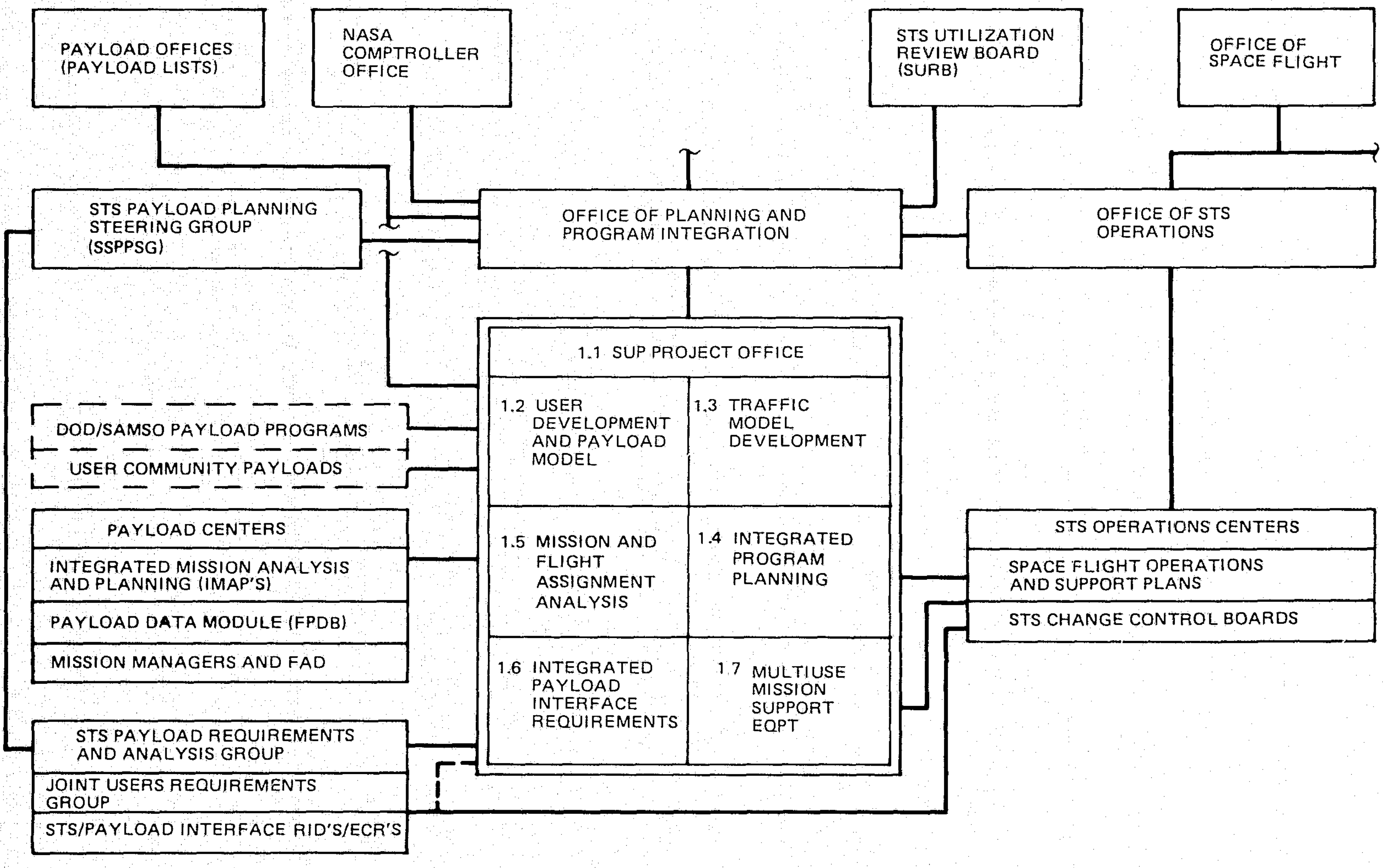

Figure 12. SUP Program Interfaces

Section 5
SUP SYSTEM IMPLEMENTATION

Development of the SUP system requires completed definition of the process and products, initiation of the process—using nonautomated techniques as necessary to produce prototype products — while completing definition and development of the required SUP (automated) data systems. The Planning Baseline document and related data systems are the major development efforts since most of the remaining documents and data systems already exist or are already in development.

5.1 SCHEDULES

The development schedules for the SUP system are presented in Figure 13. To include the start of STS flight testing (OFT) in 1979 and subsequent years within the SUP horizon, the production of SUP documentation should get underway in 1976 so that current documentation (Payload Model, Traffic Model, etc.) can be updated and a Planning Baseline prototype can be published by May 1977. This would also allow at least one year for iteration of planning and development of the first Space Flight Operations Plan before firm budgets are negotiated for operations beyond OFT, and the operation of the planning system could be validated at an early date. Thus the first operational SUP cycle is initiated in February 1977 leading to first issue of an operational Planning Baseline in May 1978. This is followed in October 1978 by the first operational version of the Space Flight Operations Plan. This development schedule is shown in Figure 8 as it relates to the orbital flight test and IOC of the STS.

5.2 STS UTILIZATION PLANNING MANPOWER

The manpower requirements associated with SUP operations were estimated in "bottom-up" fashion. Manpower for each individual task in the SUP process was estimated on the basis of manpower utilization on similar efforts in other

CR63

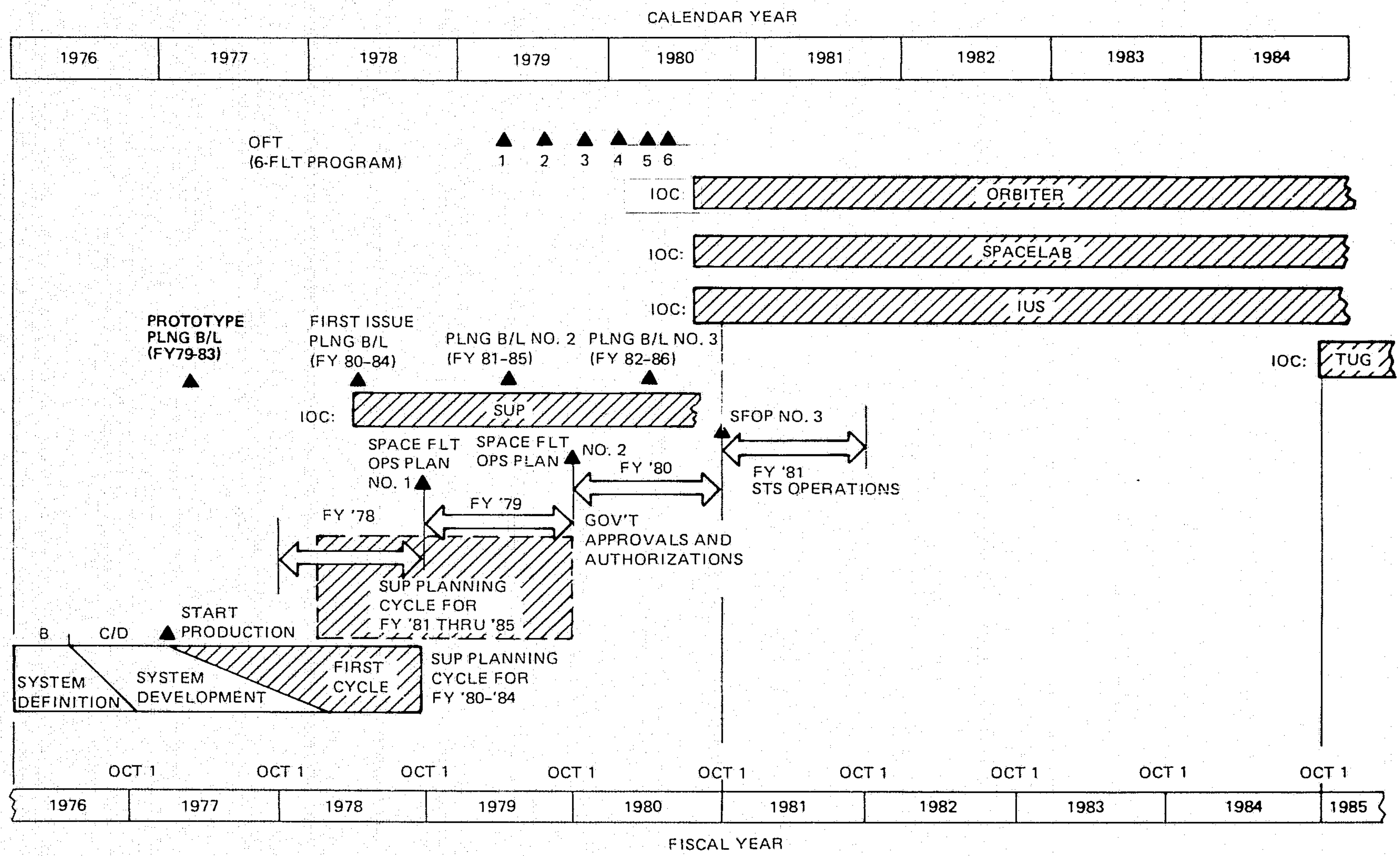

Figure 13. STS Development Schedule and SUP System Development Timetable

programs. Where experience on similar activities was not available, direct estimates were made that considered the nature of the task and its output. These estimates were then included in a SUP process simulation, and the results are summarized in Figure 14 with respect to mission rate.

The simulation indicated estimated total manpower needs ranged between 100 and 160 men. This includes the manpower required to perform integrated mission analysis and planning (IMAP) for each mission. The manpower to perform STS utilization planning only—exclusive of IMAP effort—is approximately 60 at the 30 missions/year level with only moderate increases with mission rate.

The SUP implementation phase (excluding IMAP) requires about 60 to 70 men (NASA and contracted), with about half developing the SUP Data System until late in 1976 when prototype production jumps total requirements to about 100 men. The implementation effort phases into the operational phase with the start of the SUP multicycle manloading in 1977.

It is emphasized that the manpower requirements cited here are strictly a result of the study effort, and that although selected tasks were discussed with NASA, the overall assessment is an independent MDAC product.

CR63

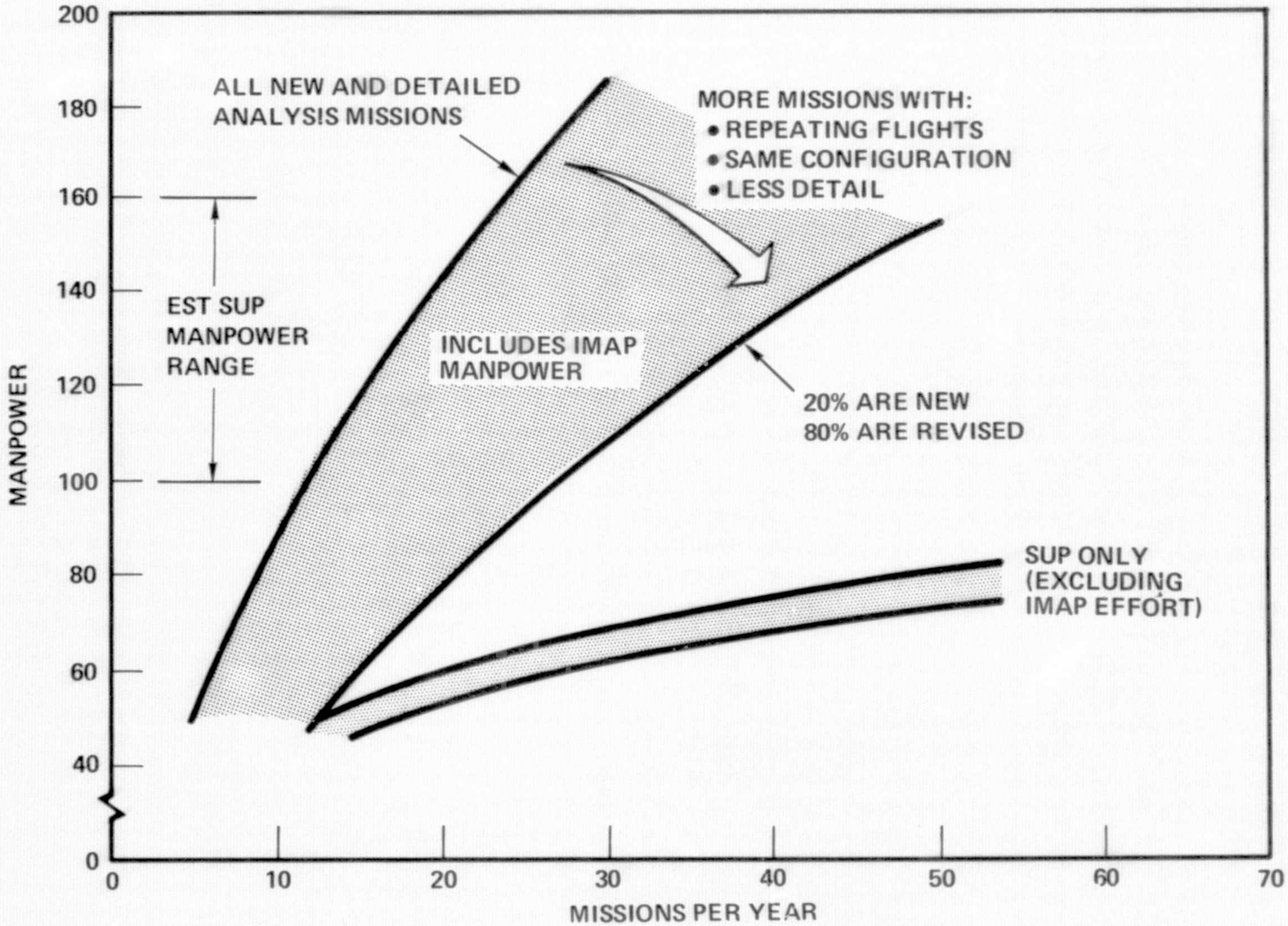

Figure 14. STS Utilization Planning Manpower

Section 6
RECOMMENDATIONS

The following items are recommended for consideration:

A. A centralized STS/Spacelab payload utilization planning office should be initiated in the near future (1976-1977 time frame).

B. The major functions of this office are:

1. Maintain and update a catalog and centralized data base of potential payloads and their descriptions, accessible for agency-wide planning.
2. Group these payloads, through capture analyses, into potential flight cargoes for long-range (12-year) traffic projections, updated semiannually, for agency-wide assessment and planning.
3. Prepare and update (annually) an agency-wide common planning baseline of the first six years of this projected traffic with consideration of integrated program milestones, contingency traffic, accommodations constraints, and funding guidelines.
4. Coordinate, support, and perform analyses of the projected payload groupings to assess cargo compatibility and mission feasibility.
5. Determine the envelope of integrated payload/STS interface requirements, including those produced by the cargo groupings and assess their potential impact on the STS accommodations (coordinated with SPRAG and JURG).
6. Identify and define potential MMSE requirements and concepts in response to the assessed integrated payload interface requirements.

C. A process for accommodating quick-response and contingency payloads should be provided which:

1. Identifies and describes the payload and the reason for the quick-response request (subject to approval).
2. Identifies the potential flight opportunities in the planned traffic.

3. Provides for approval at the levels appropriate to the impact of accommodating the request on a selected flight.

D. Flight manifest and flight approval documents should be provided for control and approval of multipayload, multiprogram missions.

E. A NASA Headquarters level review and approval board with representation from the various NASA program offices (OSF, OSS, OA, OAST) should be established for approval of multiprogram planning documents (i.e., the Planning Baseline) and multiprogram missions having Level I impacts.

F. A User Liaison office should be established in the near future as an easily identified and accessible interface for potential STS users (non-NASA) to propose or request missions and to receive guidance and support in pursuing valid proposed uses of space.